AQD Highlights 2004

Annual Report
SEAFDEC Aquaculture Department
Tigbauan, Iloilo, Philippines

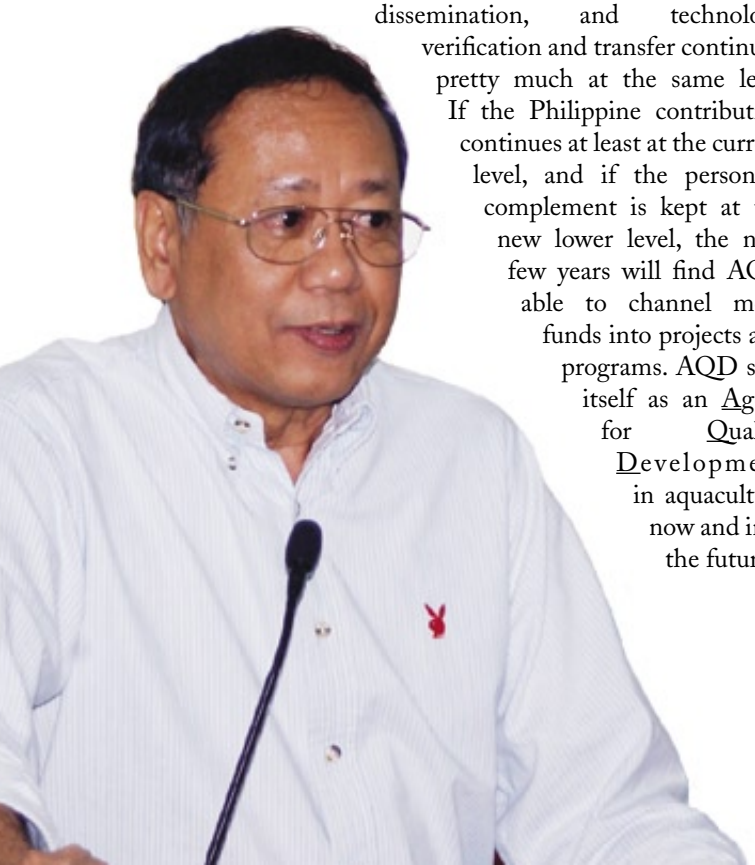
Agent for Quality Development in aquaculture

The AQD Chief reports

Now more than ever, aquaculture produces significant amounts of fish, crustaceans, mollusks, seaweeds, and other products that help ensure food security, livelihoods, and export earnings in Southeast Asia. The SEAFDEC Aquaculture Department continues to address the various constraints affecting aquaculture in the region. AQD carried out with greater vigor its mandate in research, technology verification, training and information dissemination, and technology transfer and commercialization, by implementing seven programs in 2004.

Most of the projects and activities under the seven programs in 2004 were funded by external grants, and AQD thanks all these partners. Four AQD programs were supported by the European Commission, the Japan International Research Center for Agricultural Sciences, the Fisheries Research Agency of Japan, the Australian Agency for International Development, the United States Agency for International Development, the Australian Center for International Agricultural Research, International Foundation for Science, and the Department of Agriculture Bureau of Fisheries and Aquatic Resources. Three regional programs were funded by the Government of Japan under the ASEAN-SEAFDEC Fisheries Consultative Group mechanism. Other partners and clients funded training courses, publications, and technology demonstrations. AQD hopes to build on these partnerships in the years to come.

The rather detailed report inside represents the achievements of AQD and the significant events that transpired in 2004. This year was particularly difficult for AQD and for the AQD Chief personally. The sharp reduction in the budgetary contribution of the Host Government of the Philippines led to a necessary reduction in core personnel, including many AQD Scientists. There was rancor and deep stress. Research was reduced to about half, but training, information dissemination, and technology verification and transfer continued pretty much at the same level. If the Philippine contribution continues at least at the current level, and if the personnel complement is kept at the new lower level, the next few years will find AQD able to channel more funds into projects and programs. AQD sees itself as an Agent for Quality Development in aquaculture now and into the future.



SEAFDEC Secretary General Niwes Ruangpanit and Administration and Finance Coordinator Somnuk Pornpatimakorn visit the Aquaculture Department after the Program Committee Meeting in Manila in January 2004

Inside

Prepared by

T Bagarinao (dorisb@aqd.seafdec.org.ph)
Training and Information Division
SEAFDEC Aquaculture Department

Published by

SEAFDEC Aquaculture Department
Tigbauan, Iloilo
April 2005

ISSN 1655-5228

SEAFDEC/AQD responds to Southeast Asia

AQD in the context of SEAFDEC

Programs of the Southeast Asian Fisheries Development Center in 2004

Departmental Programs	Department responsible
1. Center-Wide Information Network	SEC- IPC
2. Working Group on Regional Fisheries Policy	SEC- PPC
3. Exploration of Tuna Resources and By-catch of Tuna Fishing in the Indian Ocean	TD
4. Information and Communications Technology	TD
5. **Broodstock and Seed Quality Improvement**	**AQD**
6. **Sustainable Aquaculture Technologies**	**AQD**
7. **Collaborative R&D Program with Philippines' DA-BFAR**	**AQD**
8. **SEAFDEC-JIRCAS Collaborative Program**	**AQD**
9. Resource Assessment and Management	MFRDMD
10. Fishery Biology	MFRDMD
11. Marine Conservation and Stock Enhancement	MFRDMD
Regional Programs under the ASEAN-SEAFDEC FCG Mechanism	
1. Regionalization of the Code of Conduct for Responsible Fisheries in Southeast Asia	SEC
2. Fish Trade and the Environment	SEC
3. Digitized Atlas	SEC
4. Management of Shark Fisheries and Utilization in Southeast Asia	SEC
5. Locally Based Coastal Fisheries Management	TD
6. **Promotion of Mangrove-Friendly Aquaculture in Southeast Asia**	**AQD**
7. **Fish Diseases Diagnostic Methodologies for Aquaculture**	**AQD**
8. Conservation and Management of Sea Turtles in Southeast Asia	MFRDMD
9. Information Collection for Sustainable Pelagic Fisheries in the South China Sea	MFRDMD
10. Application of HACCP in the Fish Processing Industry in Southeast Asia	MFRD
11. Seafood Safety Information Network	MFRD
12. Chloramphenicol and Nitrofuran Residues in Farmed Fish and Fish Products	MFRD
13. Special 5-year Program on Sustainable Fisheries for Food Security in the ASEAN Region	
• Towards Decentralized Management for Sustainable Fisheries	SEC-PPC
• Improvement of Fishery Statistical System and Mechanisms	SEC-PPC
• Responsible Fishing Technologies and Practices	TD
• Resource Enhancement	TD
• Harvesting of Underexploited Resources	TD
• **Aquaculture for Rural Development**	**AQD**
• **Supply of Good Quality Seeds**	**AQD**
• Indicators for Sustainable Development and Management of Fisheries	MFRDMD
• Information Gathering for Inland Capture Fisheries	MFRDMD
• Maximizing the Utilization of Fish Catch	MFRD
• Fish Quality and Safety Management Systems	MFRD

Research

Scientific research is the method of choice for generating information and technologies for responsible aquaculture and sustainable development. AQD approved 36 research studies for implementation in 2004 (page 6), 16 with funding from the European Commission, Japan International Research Center for Agricultural Sciences, Fisheries Research Agency of Japan, Australian Center for International Agricultural Research, the United States Agency for International Development, and the University of the Philippines-Visayas. The other 20 studies were done under the three regional programs of the ASEAN-SEAFDEC Fisheries Consultative Group, with funding from the Government of Japan. AQD researchers and their collaborators published 52 scientific papers in journals and books in 2004 (pages 17-19).

AQD researchers work with European researchers on the European Commission project on the culture and management of the mud crabs Scylla spp. JH Primavera is shown second from the right

Jurgenne H. Primavera, PhD *honoris causa*

AQD Senior Scientist Jurgenne H. Primavera, PhD, was conferred a PhD in Science *honoris causa* by Stockholm University on 24 September 2004 in ceremonies held at the historic Stockholm City Hall (where the Nobel Prizes are awarded). Stockholm University awards honorary doctorate degrees to scientists and other professionals who have actively and successfully collaborated with it over the years. Since 1996, Dr. Primavera has been collaborating in scientific research and publications with the Department of Systems Ecology of Stockholm University, including Chair Dr. Nils Kautsky. Her citation reads: "In cooperation with scientists from Stockholm University, she has shown that mangroves are key areas for recruitment of fish and shrimp and that development of conventional shrimp farming may have far reaching negative economic and social implications. In order to create sustainable alternatives, she is now doing research on more sustainable integrated farming of shrimp, fish, crabs and mangrove."

Wenresti G. Gallardo, Outstanding Young Scientist

AQD Scientist Wenresti Gallardo, PhD, 40, was awarded the honor as the 2004 Outstanding Young Scientist in Marine Science by the National Academy of Science and Technology of the Philippines. The OYS award recognizes Dr. Gallardo's contributions to science and technology in the country and to the reversal of resource depletion in coastal fishing areas. He joined SEAFDEC/AQD in 1989 and worked on the hatchery and grow-out of mollusks (window pane shell, oyster, mussel, abalone and top shell). His recent focus has been on generating technologies for hatchery, grow-out, and stock enhancement of the abalone *Haliotis asinina*.

In 2003, he was awarded a grant by the International Foundation of Science (Sweden) to define methods and strategies to improve survival, growth, and reproduction of abalone released into marine reserves.

Start	% done in 2004	Title of study	Study Leaders	Approved budgets (PhP) AQD	External agencies		Expenses (PhP)
		Improvement of Broodstock and Seed					
2002	70	Culture and management of *Scylla Species:* Seed production	ET Quinitio/VR Alava		319,648	EC-CMMS	526,433
2002	90	Culture and management of *Scylla Species:* Nursery	FDP Estepa		171,436	EC-CMMS	133,653
2000	90	Improvement of growth and survival in farmed rabbitfish *Siganus guttatus*	FG Ayson		1,273,211	USAID	1,490,301
1999	100	Development of the digestive system of grouper *Epinephelus coioides* larvae	GF Quinitio		64,585	ACIAR	56,069
2000	100	Semi-intensive seed production of grouper *Epinephelus coioides*	JD Toledo		30,000	ACIAR	19,947
2004	new	Insulin-like growth factor II (IGF-II) as molecular markers for egg quality in finfish and mudcrab	J Bangcaya	50,000			0
		Technologies for Responsible Aquaculture					
2002	85	Culture and management of *Scylla* Species: Refinement of mangrove-mudcrab pen systems	JH Primavera		283,240	EC-CMMS	366,330
2002	80	Culture and management of *Scylla Species:* Fisheries of *Scylla* species in Western Visayas	JH Primavera		509,800	EC-CMMS	434,231
2002	60	Culture and management of *Scylla Species:* Geography and hydrography of Aklan mangroves	MJHL Lebata		134,400	EC-CMMS	290,530
2004	30	Poverty alleviation through aquaculture: Increasing food and income through small-scale fish farming	FG Ayson/DD Baliao		675,120	AusAID (PACAP)	758,497
2003	15	Release strategies for stock enhancement of the tropical abalone *Haliotis asinina*	WG Gallardo		249,000	IFS	185,564
2004	new	Evaluation of nutritional and microbial derivatives as immunostimulants in grouper	EC Amar	100,000	300,000	UPV	0
2004	20	Characteristics of koi herpesvirus isolates from Asia	GL Po		706,306	FRA, Japan	47,861
		SEAFDEC-JIRCAS Collaboration					
2004	10	Reproductive and larval performance of rabbitfish *Siganus guttatus*	H Ogata/DR Chavez		519,731	JIRCAS	417,347
2003	60	Pathogenesis and control of subclinical viral nervous necrosis in broodstock of grouper	I Kiryu		*600,205*	JIRCAS	615,205
2002	70	Property regimes in mangrove ecosystems	SV Siar		85,000	JIRCAS	49,496
2003	30	Property rights, governance, and adoption of mangrove-friendly aquaculture technologies	DB Baticados		240,000	JIRCAS	47,392
		Mangrove-Friendly Shrimp Farming					
2000	5	Nutrient cycles: environmental impact of mangrove-friendly intensive shrimp farming	NV Golez		887,560	GOJ-TF	13,409
2003	70	Evaluation of probiotics/waste digesters used for the grow-out of the tiger shrimp	GL Po/ TRC Mallare		713,000	GOJ-TF	246,493
		Fish Diseases Diagnostic Methodologies					
2004	new	Monitoring and surveillance of transboundary pathogens in farmed shrimps and prawns	CL Pitogo		103,450	GOJ-TF	0
2000	95	Bacteria as biological control agent against microbial diseases in shrimp and crab hatcheries	CL Pitogo		111,950	GOJ-TF	62,358
2004	new	Control of luminous bacterial disease of tiger shrimp with fish and other aquaculture species	EA Tendencia		100,000	GOJ-TF	0
2001	100	Mechanism of the effect of green water on luminous bacteria	EA Tendencia		61,000	GOJ-TF	62,800
2004	5	Prevalence of viral diseases in farmed and wild shrimps in the Philippines	LD de la Peña		233,352	GOJ-TF	0
2001	95	Preventive measures against viral nervous necrosis in fish broodstocks	LD de la Peña		223,500	GOJ-TF	269,165
2004	15	Viral nervous necrosis in wild and farmed fish in the Philippines	LD de la Peña		266,688	GOJ-TF	0
2000	75	Detection and identification of viral pathogens in farmed marine fishes	GL Po		101,800	GOJ-TF	77,698
2004	new	Surveillance of emerging fish viral pathogens in Southeast Asian countries	GL Po		343,700	GOJ-TF	0
2004	new	Immunostimulation strategies against white spot syndrome virus	EC Amar		137,780	GOJ-TF	0
2000	100	Parasitosis in marine and freshwater fishes: diagnosis, pathology, prevention, and control	EC Lacierda		55,600	GOJ-TF	96,151
2004	100	Histopathology of koi herpesvirus disease	EC Lacierda		512,249	GOJ-TF	399,046
2004	40	Hematology of koi *Cyprinus carpio* infected with koi herpesvirus	EC Amar		333,350	GOJ-TF	138,827
2004	20	Virucidal effects of various disinfectants on koi herpesvirus	EA Tendencia		380,300	GOJ-TF	292,040
2004	20	Transmission and control of koi herpesvirus	GL Po		683,197	GOJ-TF	525,196
2004	60	PCR-based detection method and phylogenetic analysis of koi herpesvirus from Asian countries	LD de la Peña		722,400	GOJ-TF	324,030
		Integrated Regional Aquaculture Program					
2003	50	Verification of hatchery rearing techniques for rabbitfish: use of larval diets	FG Ayson		401,719	ASEAN	202,522
2004	40	Morphometric characterization of *Macrobrachium rosenbergii* and related species in the Philippines	MR Eguia/ MLC Aralar		275,000	ASEAN	
2003	10	Development of practical diets for larvae of snapper and seabass	IG Borlongan		152,000	ASEAN	0

EC-CMMS European Commission - Culture and management of the mud crabs *Scylla* spp., USAID United States Agency for International Development ACIAR Australian Center for International Agricultural Research, Australian Agency for International Development, IFS International Foundation for Science, UPV University of the Philippines Visayas FRA Fisheries Research Agency, JIRCAS Japan International Research Center for Agricultural Sciences, GOJ-TF Government of Japan Trust Fund, ASEAN Association of Southeast Asian Nations

Improvement of broodstock and seed

The mud crabs *Scylla serrata, S. olivacea,* and *S. tranquebarica* have been the focus of much research at SEAFEC AQD over the past five years, funded externally by the European Commission. In 2004, several studies were done on broodstock management and improvement of larval survival. Research on other commodities was put on hold in 2004 due to lack of AQD funds. However, more training in seed production was conducted under this Program.

Size grading crabs to prevent cannibalism

Microwire tags are used to track individual mud crabs in a variety of studies; the tags are then read and decoded

Broodstock diet and larval quality. Adult *Scylla serrata* were fed formulated diets with either 6, 9, or 12 % lipid (as squid oil and soybean lecithin) alone, or with natural food (mussel, squid, or fish) given on alternate days. The lag time from ablation to spawning (32-56 days) and the duration of embryonic development (10-14 days) did not vary significantly among diets. Crabs fed natural food alone or with formulated diets produced significantly more zoeae than those fed formulated diets only. Second spawning in captivity occurred in all crabs except those fed only the formulated diets. Broodstock fed formulated diets had blackened ovaries. Lipid levels in broodstock tissues and newly hatched zoeae increased with dietary lipid level. Tissue lipid was also higher in crabs fed formulated diet with natural food than in those fed only formulated diet. The combination diets increased the essential fatty acids in broodstock and zoeae and improved performance.

Functional and physiological maturity. Hatchery-reared *Scylla serrata, S. tranquebarica* and *S. olivacea* raised in earthen ponds were examined over time for size and sexual maturity. Under the microscope, sexual differentiation can be seen in crab instars of 1.5 cm carapace width. The gonads can be distinguished in 8 cm *S. serrata,* 6 cm *S. tranquebarica* and 6 cm *S. olivacea.* The smallest females with vitellogenic oocytes were 12 cm *S. serrata,* 9.6 cm *S. tranquebarica,* and 8.3 cm *S. olivacea.* Mating readiness occurred at smaller carapace width in *S. olivacea* (female 8.3 cm, male 7.7 cm) than in *S. tranquebarica* (female 10.9 cm, male 8.6 cm) and *S. serrata* (female 12.2 cm, male 11.6 cm). All males at these sizes had spermatophores in the anterior vas deferens, and females had ovaries starting to mature.

Lipids and fatty acids in wild and pond-reared mud crab during ovarian maturation. Wild-caught and pond-reared female *Scylla serrata* at different stages of ovarian maturation were collected from Samar and Capiz, Philippines. Crabs were categorized into five stages according to the microscopic appearance of the most advanced oocytes. Ovaries, hepatopancreas, muscle, and newly spawned eggs were analyzed for lipids and fatty acids. Total lipid was higher in pond-reared crabs than in wild-caught crabs but increased with ovarian maturation in both groups. Ovarian lipid peaked at the late vitellogenic stage, coinciding with a decline in the hepatopancreatic and muscle lipids. Lipid levels declined significantly in spent females. The tissues always contained highly unsaturated fatty acids such as eicosapentaenoic (20:3n-3), docosahexaenoic (22:6n-3), and arachidonic (20:4n-6) acids, but at higher levels in vitellogenic and late vitellogenic ovaries and in newly spawned eggs.

Agonistic behavior of *Scylla serrata*. The behavior of juvenile *S. serrata* (2.5–4.5 cm carapace width) was recorded with a video camera. Displays included threat, attack, fight, defense, retreat, and rest. Threat was the dominant behavior and fight was the least common. There was no significant difference in displays between males and females. Another study compared the behavior of crabs with intact, trimmed, or missing chelipeds in contests against crabs with the same or different cheliped condition. Significantly more fights occurred between intact and trimmed crabs than between trimmed and no-cheliped crabs. Crabs with missing chelipeds always lost against those with intact or trimmed chelipeds.

Nursery of *Scylla serrata* with different feeds. Megalopa stocked at 5/m² in mesh nets suspended in ponds were fed either mussel meat, a formulated diet, or a combination of both. After one month, survival ranged from 36 to 59% and did not significantly differ among the treatments. The formulated diet contained the following (amount in g/kg): fish meal 160, squid meal 140, *Acetes* 160, defatted soybean meal 175, bread flour 100, rice bran 40, lecithin 15, carboxy-methyl 30, vitamin mix 50, mineral mix 40, cod liver oil 40, Dicalplus 20, seaweed 30.

Molting and growth at different salinities. Survival of instars of *Scylla olivacea* and *S. serrata* was not significantly affected by test salinities. Instars of *S. tranquebarica* survived best at 16 ppt (100%), less so at 8 ppt and 20 ppt (85-88%), and least at 24-32 ppt (53%). Molt intervals in *S. olivacea* were longer at 24-32 ppt than at 12-20 ppt. The mean body weight and carapace width of *S. tranquebarica* and *S. serrata* were significantly lower at 32 ppt than at the other test salinities. Instar *S. olivacea* grew best at 12-16 ppt and poorest at 32 ppt.

Grow-out of hatchery-reared and wild crabs. Two ponds were stocked with an equal mix of hatchery-produced (H) and wild-sourced (W) juveniles, two ponds with H only, and two ponds with W only. After three months, survival was 31.2% H and 27.5% W in the mixed-stock ponds, 50% in the H ponds, and 43% in the W ponds. Wild juveniles had significantly higher body weights and carapace widths than hatchery-produced juveniles. H juveniles grew better in the H ponds than in the mixed-stock ponds.

Improvement of growth and survival of rabbitfish: use of larval diets. An experiment on the use of larval diet in rearing rabbitfish larvae was conducted.

- Control – rotifers (20/ml) alone from day 2
- T1 – rotifers and larval diet (1 g/ton-day) from day 2, weaning at day 8
- T2 – rotifers and larval diet from day 2, weaning at day 15
- T3 – rotifers and larval diet from day 8, weaning at day 15
- T3 – larval diet alone from day 2

Only fish in the control group survived beyond metamorphosis. Mass mortality occurred in the other treatments a few days after rotifers were withheld.

Two rearing runs were then conducted with 3 treatments:

- Control – rotifers (20/ml) alone from day 2
- T1 – rotifers (5/ml) and larval diet (1 g/t-d) from day 2
- T2 – rotifers and larval diet from day 8

Survival beyond metamorphosis was higher in larvae fed rotifers with larval diet than in the control group fed only rotifers. In run 1, average survival after metamorphosis was 1.4%, 2.8% and 3.7% in the control, T1, and T2, respectively. In run 2, survival was 5.7%, 9.0%, and 8.5% in the control, T1, and T2. Survival is similar whether larval diet was given on day 2 or day 8. Rabbitfish larvae can not be reared without rotifers from day 2 to 21, but can be reared on combination of rotifers and larval diet from first feeding. Use of an appropriate larval diet would significantly reduce the rotifer requirement in the rabbitfish hatchery. This further allows the reduction of tank facilities for propagation of natural food in hatcheries.

Hatchery session during the Crab Seed Production training course

AQD researchers were actively involved in training on mud crab. They held classes for the members of the Napti Multi-Purpose Cooperative, which helps them in the EC project. Then they conducted the 5th Training Course on Mudcrab Seed Production from 7 Sep to 6 Oct for 15 trainees, including three from Cambodia, Myanmar, Vietnam, and India, and 11 were from the Philippines, from the private sector.

Also under this Program, training courses on marine fish hatchery and abalone hatchery were conducted at AQD Tigbauan. The Marine Fish Hatchery training course was conducted from 2 Jun to 16 Jul for six Filipinos and one Vietnamese. AQD's first Training Course on Hatchery and Grow-out of Abalone *Haliotis asinina* was held from 17 to 26 November. There were 24 trainees–all Filipinos, except IBM Suastika Jaya, the Director of Marine Aquaculture Development Center in Lombok, Indonesia. Ten trainees were sponsored by the Philippines' Bureau of Fisheries and Aquatic Resources through the Fisheries Resources Management Program; the others were from the private sector.

Laboratory session during the abalone hatchery training course

Technologies for responsible aquaculture

Under this Program were done studies on mudcrab grow-out and related ecological studies on mud crabs and mangroves, funded by the European Commission. A study on abalone stock enhancement was also started. Training in aquaculture as livelihood was provided to a variety of clients at AQD's various stations and collaborating farms and facilities. AQD also initiated new aquaculture projects with the Australian Agency for International Development, and with Ngatpang State in Palau.

Harvest of mud crabs in pens built among the mangroves in Aklan

Release of tagged mud crabs into the mangroves

Refinement of mangrove-mudcrab pen system. Analysis of mangrove community structure in the Zarraga mangrove–mudcrab pens in 2004 revealed lower biomass (stand basal area) inside the pens (8 m²/ha) than outside (14 m²/ha). Likewise, total mangrove count was higher inside the pens than outside. Over a 2-year period, mangrove plants increased in number and biomass despite the stocked mud crabs. The next run was conducted at an ongoing mudcrab pen project in Batan, Aklan. Six mangrove pens (area 167 m²) were each stocked with 130 wild and 15 hatchery-reared juveniles of *S. serrata*. Crabs in three ponds were fed fish; those in three ponds were fed fish and low-cost pellets. After 5 months, body weights (203-267 g) and survival were similar. Thus, fish can be partly replaced by low-cost pellets as feed for mud crabs. Higher survival was observed in pens facing the open sea (with high flushing rate). Pens with poor flushing and mixed crab sizes had the lowest survival.

Geography and hydrography of Ibajay and Kalibo mangroves. Study sites for the fisheries of *Scylla* spp. have been plotted in the new mangrove maps in Kalibo and Ibajay, Aklan. Mangroves in Ibajay were divided into sampling areas for the mark-recapture experiment and stock enhancement of *Scylla.* Four sites of total area 25.6 ha were identified for the mark-recapture experiment, where four crab fishermen will work in cooperation with the researcher.

Fisheries of *Scylla* species in Western Visayas. A sequential mark-recapture study was done to measure abundance, growth, and movements of the crab population in the mangroves of Naisud-Bugtong Bato, Ibajay, Aklan. Three species of *Scylla* (n=823) comprising 98.5% *S. olivacea*, 0.6% *S. serrata*, and 0.9% *S. tranquebarica* were tagged with microwire tags and released at 4 different branches of the two major rivers traversing the mangroves. Of six batches of crabs released, 30-46% were recovered.

Stock enhancement trials were made using hatchery-reared *S. serrata* and *S. tranquebarica* and wild *S. olivacea.* Survival and growth of these stocks in the mangroves was determined. Of the total crabs tagged and released at three sites, recapture was 41% for *S. olivacea*, 8% for *S. serrata*, and 1% for *S. tranquebarica*. The low recapture of hatchery-reared *S. serrata* and *S. tranquebarica* indicated high predation and the need for behavioral training before release into the wild.

Release strategies for stock enhancement of the tropical abalone *Haliotis asinina*. A total of 1,800 diet-tagged abalones of three size ranges were released in March into Carbin Reef in the Sagay Marine Reserve. Survival, exit from release modules (PVC pipes), and dispersal from the release point were monitored during the first three days. There was no mortality after the 8-h transport from Tigbauan. Small abalones left the pipes faster, but did not disperse as much as the medium and large ones. Mortality two days after release was 2%, apparently due to predation by crabs.

Binangonan Station's concrete ponds for experiments on freshwater fishes

AQD's Binangonan Freshwater Station continued research in genetics and farming systems, formed partnerships with the private sector, strengthened relations with nearby schools and local governments, and conducted more intensive training in freshwater aquaculture for a variety of clients, often in cooperation with the Aquaculture-Based Countryside Development Enterprises Foundation Inc.

A special training course on Freshwater Aquaculture Operations and Management was conducted from 15 Apr to 28 May for 11 teachers from different fisheries schools in Mindanao under the Industry Immersion Program of the Philippines' Technical Education and Skills Development Authority. BFS and ABCDEF then conducted a Training Workshop on Responsible Freshwater Aquaculture on 25-27 Aug for the Municipal Agricultural Officers and fish farmers in the provinces of Rizal and Laguna. Since then, more training sessions have been held to assist Municipal Agricultural Officers and local government officials in implementing aquaculture-based livelihood projects. The Workshop on Freshwater Aquaculture Livelihood Project Planning and Development held in September was attended by 19 participants, and the four training modules conducted in Antipolo, Nagcarlan, Sta. Cruz, and Binangonan in December had a total of 150 participants.

Dumangas Station tests modifications of the AQD shrimp farming technology

AQD's Dumangas Brackishwater Station continued to be the focal site of the shrimp farming projects implemented by the Technology Verification and Commercialization Division and the Mangrove-Friendly Shrimp Farming Program. Some of the shrimp harvest from these projects were sold to AQD employees. Dumangas Station hosted many of AQD's trainees in 2004 and there they learned the practical skills in grow-out of shrimps, milkfish, and mud crabs.

Similarly, Igang Marine Station and Mariculture Park served as technology demonstration and training sites. AQD's trainees learned the day-to day operations of grow-out cages for milkfish, grouper, snapper, and abalone. Some of the cage-grown milkfish were sold to AQD employees; most were marketed at the Iloilo Fishing Port.

Grouper harvested from cages in the Mariculture Park

Trainees produce abalone seed in the hatchery and grow them out in marine cages at AQD's Igang Station

AQD Scientists proposed the AusAID project during the Bagong Paraan competition in January

AQD aquaculturists in the Technology Verification and Commercialization Division took over the implementation of a new project funded by the Australian Agency for International Development, *Poverty alleviation through aquaculture: increasing food and income through small-scale fish farming* for a beneficiary fisher association (MACABATA, comprising eight fishing barangays) in Carles, Iloilo, Philippines. The implementation approach considered the fishfarming experience of the beneficiaries, the marketability of the selected commodity, and the technical, environmental, and financial viability of the farming system. The association decided first to learn to farm groupers in fish cages. Two AQD technicians were deployed to Carles on 22 Sep. After site suitability was assessed, 16 fish cages were set up off Manlot Island and stocked with the grouper *Epinephelus coioides.* Each barangay in the association was allotted two fish cages to operate. To transfer the grouper cage farming technology to the association, two trainees from each barangay worked day to day at the cages under the guidance of the AQD technicians. The plan is to help the barangays conduct one or two farming runs. Once the barangays have demonstrated adequate management and technical capability, AQD will recommend to AusAID the complete turnover of the grouper cages to the beneficiaries.

AQD also forged a consultancy agreement with Ngatpang State, Palau in July for a one-year project involving verification of seed availability in the wild, construction of a 14-hectare modular milkfish pond system, construction of fish cages, and operation of the built facilities to demonstrate technical, environmental, and economic viability of different aquaculture technologies. AQD dispatched an 11-man aquaculture engineering team to Ngatpang State, Palau, on 3 Aug. An abandoned pond has been rehabilitated for grow-out of milkfish. Fish cages have been built and stocked with grouper seed. Pens have been built in the mangroves for mudcrab grow-out and fattening.

Mud crabs collected in the Ngatpang mangroves for fattening in pens

Mud crab pens in the mangroves of Ngatpang, Palau

Transport of grouper seed to the cages in Carles, Iloilo

Other Service Labs

Microtechnique Lab

Processed for histological slides were a total of 525 samples including liver, gills, kidney, spleen, heart, skin, muscles, intestines, brain, eyes, hepatopancreas, gonads, and swimbladder from shrimps, mud crabs, and different fishes. A total of 1,078 slides were prepared for histological analysis.

Larval Food Lab

A total of 1,723 liters of starter suspensions of *Chlorella* sp., *Tetraselmis* sp., *Chaetoceros* sp., *Brachionus* sp., *Skeletonema* sp. and *Artemia sp.* were provided to AQD researchers and the private sector. Hatching efficiency and hatching rate of different *Artemia* brands were determined upon request of the private sector. Nine students did their practicum and thesis work at the Larval Food Lab.

Pilot Feed Mill

A total of 13,225 kg of various milled feeds and dispensed feed ingredients were served.

Abalone Hatchery

In 2004, the total number of eggs/trocophore larvae from spontaneous spawning of the abalone *Haliotis asinina* was 118,102,780, and 21,181,105 (18%) reached the veliger stage. The abalone hatchery produced 16,414 juveniles (about 2 cm in shell length, 1 gram in body weight). Most of the juveniles were sold to the private sector, and some were grown out in the cages at Igang Marine Station.

The standard method for abalone hatchery is as follows. Gravid abalones are selected from the conditioning tank and stocked in 3-ton concrete tanks for spontaneous spawning. Eggs and trocophore larvae are collected at 0700-0800 H and incubated in flow-through UV-treated sea water. At 1500 H, the swimming veliger larvae are stocked in tanks with UV-treated sea water and corrugated plastic sheets (roofing) as settlement plates. These settlement plates are previously prepared to grow crustose coralline red algae and the benthic diatoms *Navicula sp*. and *Amphora sp.* The UV-treated sea water is left to stand for 5–7 days, corresponding to the swimming larval stage. The larvae start to settle at days 5–10. Stocks of mixed diatoms are added to the larval tanks to maintain sufficient food for the settled larvae until they reach sizes of 6–10 mm at 2–3 months.

Juveniles are grown out in modular net cages, fed *ad libitum* with fresh seaweed *Gracilaria* spp. Some juveniles intended for stock enhancement are fed with SEAFDECformulated diet to tag them with the bluish green band on the shell that makes them recognizable out on the reef.

Laboratory for Advanced Aquaculture Technologies

Molecular Endocrinology and Genetics Lab

Changes in the mRNA expression of gonadotropins GtHI-ß and GtHII-ß in the pituitary gland of female and male rabbitfish *Siganus guttatus* were measured at different phases of the lunar cycle. RT-PCR assay showed low mRNA levels of GtHI-ß and high GtHII-ß in both sexes during the first quarter moon (the spawning quarter. Both gonadotropins are highly expressed in females during the full moon, and GtHI-ß in males during new moon.

Changes in the mRNA expression of pituitary growth hormone (GH) and hepatic insulin-like factor I (IGF-I) in grouper *Epinephelus coioides* in response to starvation and refeeding were examined by RT-PCR assay. GH mRNA expression significantly increased after two weeks of starvation, and more so after 3-4 weeks. GH mRNA expression in fed control fish did not change during the same period. Hepatic IGF-I mRNA expression significantly decreased after one week of starvation, and even further after 3-4 weeks. There was no change in IGF-I mRNA expression in fed controls. One week of refeeding restored mRNA activity to normal levels.

Disease Diagnosis Lab

A total of 247 samples were examined for disease diagnosis and bacterial load monitoring. The samples consisted of 170 (69%) shrimps, 20 fish, 47 crab and other crustaceans, and 10 water samples. The bulk of the samples (197, 80%) came from the private sector, 45 samples from within AQD, and 5 samples from the University of the Philippines - Visayas and the Bureau of Fisheries and Aquatic Resources.

The diseases diagnosed included viral nervous necrosis (VNN), monodon baculovirus (MBV), and white spot syndrome virus (WSSV). The frequency of disease occurrence was as follows: 12 of 12 fish samples VNN-positive, 13 of 13 shrimp samples MBV-positive by malachite green staining, 1 of 1 sample MBV-positive by PCR, 86 of 119 shrimp samples WSSV-positive, 34 of 44 crab samples WSSV-positive, and 2 samples had parasites.

Other services included sale of 48 tubes (P2,100/tube) of master mix for PCR to a private fish health laboratory and one bacterial isolate (P100/isolate) to students of the University of San Agustin. Use of microscopes for photomicrography (P200/hour) was also allowed for students of West Visayas State University, UPV, and USA.

Centralized Analytical Lab

A total of 184 water samples were analyzed for pH, nitrite, ammonia, phosphate, and total alkalinity; 72 soil samples for available iron, available sulfate, and available phosphate; and 153 feed ingredient samples for moisture, crude protein, crude fat, fiber, ash, and phosphorus.

AQD collaboration with DA-BFAR

SEAFDEC AQD works closely with the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture of the Philippines. Collaboration is mainly through two mechanisms. One is the joint operation and maintenance of the Laboratory for Advanced Aquaculture Technologies (also known as the Biotech Lab), which is located at the AQD campus in Tigbauan, but is owned by the Government of the Philippines as a grant-in-aid from the Japan International Cooperation Agency. The other is through the Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP).

Due to severe budget cuts, AQD alone cannot make full use of the Biotech Lab. Universities and other research institutions have been invited to avail of the excellent facilities and equipment – on a cost-sharing basis. AQD hosted a roundtable discussion at the Tigbauan Main Station on 23 July to formulate guidelines for the use of the Biotech Lab. In attendance were UnderSecretary Cesar Drilon of the Department of Agriculture, Director Malcolm Sarmiento of the Bureau of Fisheries and Aquatic Resources, and representatives of the Bureau of Agricultural Research, the Philippine Council for Aquatic and Marine Resources Research and Development, the National Fisheries Research and Development Institute, BFAR Region 6, the University of the Philippines Marine Science Institute, and the UP College of Fisheries and Ocean Sciences. The AQD representatives were AQD Chief RR Platon, JH Primavera, and WG Yap. Discussed at the meeting were the administrative responsibilities of AQD and BFAR, laboratory maintenance and security, power and water bills, user fee rates, personnel requirements, budgets, and other matters.

DA UnderSecretary Cesar Drilon and BFAR Director Malcolm Sarmiento explain the use of the Laboratory for Advanced Aquaculture Technologies

Shrimp Congress 2004 was held in Cebu City from 30 March to 1 April, sponsored by BFAR, in cooperation with the Philippine Shrimp Industry, SEAFDEC/AQD, and the National Agriculture and Fisheries Council. The Shrimp Congress aimed to assess, evaluate, and determine the impacts of new technologies on the profitability and competitiveness of the industry. The topics discussed included scientific innovations, ecology, economics, political constraints, and the ways to insure the sustainability of the industry. AQD Scientist JH Primavera talked on "Treatment of shrimp pond effluents by a natural mangrove wetland," ET Quinitio on "Shrimp breeding in the Philippines," and LD de la Peña on "White-spot syndrome virus: status of shrimp spawners." AQD's participation was funded by JMANTTP.

In 2004, 10 trainees from BFAR took the AQD training course Hatchery and Grow-out of Abalone and another 10 took the course Detection of White-Spot Syndrome Virus by PCR.

AQD Scientists LD de La Peña and ET Quinitio at the Shrimp Congress 2004

JMANTTP first implemented *Oplan Sagip Sugpo* for the rehabilitation of the shrimp industry consistent with the MakaMASA Program for Fisheries, the Agriculture and Fisheries Modernization Act, and Republic Act 8550. AQD's Dumangas Brackishwater Station verified technologies for sustainable shrimp farming. Then the technologies were demonstrated at the BFAR Demonstration and Training Centers in Calape, Bohol; Lala, Lanao del Norte; and Botong, Taal, Batangas. Technology demonstration and technical assistance were later provided to private shrimps farms: 10 in Panay Island, five in Negros, three in Luzon, and one in Mindanao.

JMANTTP also verified several grow-out technologies for milkfish, grouper, sea bass, rabbitfish, tilapia, and mud crabs, and demonstrated these in government farms and private farms. For example, nursery and grow-out of hatchery-reared milkfish has been demonstrated at one farm in Negros and six farms in Panay Island.

JMANTTP's techno-demo projects have been implemented by AQD Aquaculturist Dan Baliao and the staff of the Technology Verification and Commercialization Division. In 2004, TVCD continued to intensify technology transfer in the Philippines.

Shrimp ponds at the National Fisheries Biological Center in Botong, Taal, Batangas

Shrimp ponds of the Demonstration and Training Center in Lala, Lanao del Norte

The shrimp ponds at the Demonstration and Training Center in Bentig, Calape, Bohol

SEAFDEC-JIRCAS collaboration

The Japan International Research Center for Agricultural Sciences, based in Tsukuba City, collaborates with SEAFDEC on the project, *Studies on sustainable production systems of aquatic animals in brackish mangrove areas* (fiscal year 2001-2005). In 2004, JIRCAS Scientists Dr. Hiroshi Ogata and Dr. Ikunari Kiryu conducted two research projects at AQD, one on the effect of essential fatty acids and vitamins on reproduction of marine fishes, and another on viral nervous necrosis in groupers (results below). Another JIRCAS Scientist, Dr. Yoshimi Fujioka, conducted a study in Thailand–on the role of benthic organisms as food for marine resources – and he presented the results during the Regional Technical Consultation on the Sustainable Use of Mangroves for Aquaculture, held in Bohol, Philippines in August 2004. Through JIRCAS' Counterpart Researcher Invitation Program, AQD's Esteban Garibay underwent training on fatty acid analysis at JIRCAS and on vitamin E analysis at the National Research Institute of Aquaculture in Mie from 27 January to 7 March 2004 under the guidance of Dr. Hiroshi Ogata and Dr. Hirofumi Furuita.

ES Garibay prepares rotifer enrichment tanks at the AQD hatchery, analyzes fatty acids at the JIRCAS laboratory, and enjoys the plum blossoms in Tsukuba with Dr. Ogata

Reproductive and larval performance of rabbitfish *Siganus guttatus* given arachidonic acid supplements. Arachidonic acid (ArA) has recently been shown to improve reproductive performance and larval survival in tropical marine fishes. A feeding test was done on rabbitfish *Siganus guttatus* broodstock. Three diets were tested on groups of 5 males and 5 females (340-810 g body weight) in 5-ton concrete tanks. Diet 1 was a basal diet with 1% soybean oil + 6% cod liver oil; Diet 2 had the soybean oil replaced with 0.75% ArA; Diet 3 had all of the soybean oil and a part of cod liver oil replaced with 1.5% ArA. Fish were fed twice at 4% of biomass/day. The breeders were allowed to spawn naturally. The eggs of *S. guttatus* are demersal and strongly adhesive on the walls of the spawning tank, and it was difficult to collect and count the spawned eggs. Best spawning and hatching was obtained with the diet containing 0.75% ArA, and the poorest result with the diet containing 1.5% ArA. The optimum supplementation rate in diets for broodstocks of tropical marine fishes might be around 0.5% ArA, as determined earlier for mangrove snapper.

Experiments were also done to incorporate ArA in rotifers for rabbitfish larvae. Rotifers that were reared on either baker's yeast, *Nannochloropsis sp.*, or the diet Culture Selco, were enriched over 24 h with DHA (docosahexaenoic acid) Protein Selco with and without supplemental 5% ArA. Fatty acid analysis of the freeze-dried rotifers showed that dietary ArA can be incorporated into rotifers. Rotifers reared in culture Selco and then enriched with DHA Protein Selco showed the best balance of essential fatty acids, with ratios of 1.3 ArA/EPA (eicosapentaenoic acid), 2.2 DHA/EPA, and 1.7 DHA/ArA. In another experiment, rotifers reared on Culture Selco were enriched with DHA Protein Selco plus 5, 10, 15, and 20% ArA. Results showed that ArA incorporation in the rotifers was directly proportional to the ArA levels in the diet. However, EPA and DHA levels in the rotifers decreased as the ArA level increased. The optimum ArA level for incorporation into rotifers seemed to be less than 5% of the DHA; higher ArA inhibited the absorption and/or accumulation of EPA and DHA in rotifers.

Fatty acids and fat-soluble vitamins in milkfish larvae from the wild and from the hatchery. Three batches of wild milkfish larvae (4–7 mg) from different localities, and 12 batches of hatchery-reared larvae and juveniles (different ages and weights, 3 mg–26 g) were analyzed for ArA, EPA, DHA, Vit A, and Vit E. Wild larvae had about 3% ArA, 7% EPA, and 20% DHA (% of total fatty acids), 20 IU Vit A/g fish, and 28-130 µg Vit E/g fish. The corresponding values in hatchery-reared larvae were 3-9% ArA, 2-12% EPA, 2-25% DHA, 13-57 IU Vit A/g fish, and 16-229 µg Vit E/g fish. Most of the differences in values between wild larvae and hatchery-reared larvae and juveniles could be due to age, or weight, or prior feeding history. Hatchery-reared larvae had higher ArA, similar EPA, but much lower DHA than wild larvae of similar and age. These results indicate that milkfish larvae in the hatchery must be fed rotifers enriched with DHA. Marine fish larvae can not synthesize DHA, EPA, and ArA and must get these in the diet. EPA and DHA are essential components of phospholipids in cell membranes. DHA improves resistance to stress in larval and juvenile fish.

Pathogenesis and control of subclinical viral nervous necrosis (VNN) in grouper broodstock. The major infection route of VNN is considered to be vertical transmission via gonad of subclinically infected broodstock. Investigation regarding such broodstock is needed in order to prevent the disease. Five healthy *Epinephelus coioides* (4-12 kg body weight) were used, two from AQD Tigbauan and three from the Inland Sea Ranching Station in Puerto Princesa City, Palawan. The fish were aseptically dissected, and 14 different tissues were collected from each. For cell culture using E-11 cell line and RT-PCR methods, the tissues were stored in –80°C. Samples for histopathology were fixed in 10% buffered formalin. Additionally, 11 wild juvenile groupers (8 *E. coioides* and 3 *E. malabaricus,* 2-4 g body weight) were purchased from a grouper supplier in Roxas City, Capiz. Five different tissues were collected from each fish, and stored in –80°C for RT-PCR assay.

In order to detect VNN virus from fish tissues, the RT-PCR, nested PCR, cell culture, and combination of cell culture and RT-PCR were used. A suitable method for virus detection in the tissues of asymptomatic fish was determined. The latent virus was difficult to detect by cell culture or even by the combination method. These methods also required longer period and were not suitable for handling many samples. Random hexamers were used in the synthesis of cDNA, and additional two new primer sets were used which resulted in the improvement of both the RT-PCR and nested PCR. The method of virus detection using PCR was standardized.

Analysis using an improved PCR assay detected VNN in in the 5 breeders and 9 of 11 juveniles sampled. The highest ratio of virus detection was in brain and eye, 14/16 brains and 8/11 eyes positive for VNN. But other tissues were also found positive for VNN: 6/16 gills, 4/13 spleen, 4/10 kidney, 3/5 blood, 5/5 intestine, 5/14 liver, 3/4 gonad, 4/5 swim bladder, and 4/4 skin. Histological analysis will also be done using fluorescent antibody technique. Once the distribution of the virus is clarified, virus transmission may be understood, and preventive measures may be developed.

Brackishwater Aquaculture in Western Visayas

Tsutomu Matsuura
Susana V. Siar, Nerissa D. Salayo, Didi B. Baticados

Total aquaculture production in Western Visayas was 88,711 mt in 1995 and rose to 99,258 mt in 2001 due to increase in seaweeds. The value, however, dropped from PhP 8.5 B in 1995 to PhP 3.4 B in 2001 due to reduction in tiger shrimp. The commodities in descending order of market prices in 2001 are tiger shrimp, grouper, mudcrab, milkfish, oyster, seaweed, and mussel. Tiger shrimp, grouper, and seaweed are for export, but grouper prices were low in 1999-2000 due to economic weakness in Taiwan, Hong Kong, and other importer countries.

All tiger shrimp are produced in brackishwater ponds, and production in Western Visayas reached a high of 33,958 mt in 1995, but has stabilized around 1,000 mt since 1998. The main reason for this huge decline was the outbreak of luminous bacterial disease and various viral diseases that forced many intensive farms in Negros Occidental to stop operations. Farms now operate at the low-cost extensive level, or shift to environment-friendly intensive systems using reservoir ponds for intake water, where tilapia is raised to produce 'green water' which effectively controls bacterial diseases.

Milkfish is mainly raised in brackishwater ponds, but there has been an increase in production from cages and pens since 1999, when fish prices were high. The national production rose to 232,000 mt in 2002 from 170,000 mt in 1999. The glut caused milkfish prices to fall in 2002 and forced some intensive farm operators to quit the business.

A variety of species comes from small-scale aquaculture. Oyster production has been increasing since 1999 but mussel production has had large annual fluctuations. Grouper production in ponds was highest in 2001. Production of mud crab has been increasing since 1997. Seaweed production volume has increased so high as to more than compensate for the 50% fall in seaweed prices.

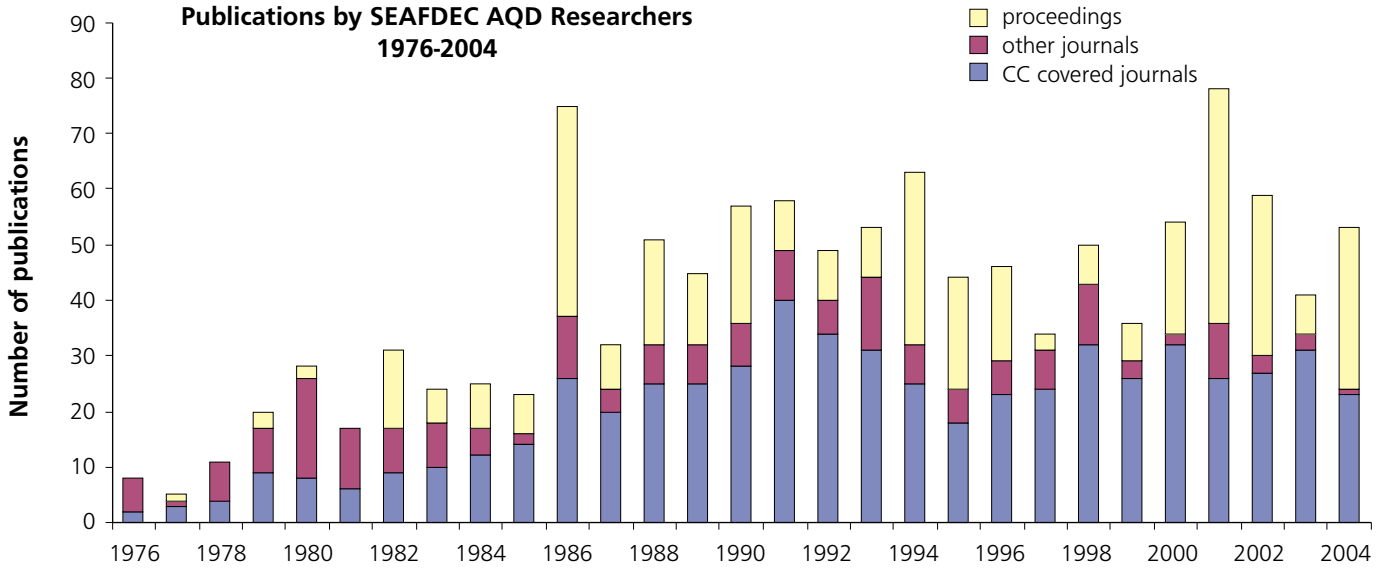
Brackishwater ponds are mainly operated by business people or merchants engaged in businesses other than fishing, who live inside or outside of the pond locality. Small-scale farms are mostly operated by local residents and coastal fishers, many of whom are 'poor'. Milkfish cages and pens require commercial pellets and the operators are middle-class.

Mangrove replanting is now being widely encouraged by the central and local governments alongside small-scale aquaculture to produce a variety of fishes, crustaceans, and mollusks for food and income.

A survey was conducted in Ivisan and Carles in northern Panay. In Ivisan, primary income is from fishing and secondary income from aquaculture. About 29% of the farms started in 1997-1999, and 71% started in 2000-2003. Carles has households engaged in a variety of other work and businesses, but many have turned to aquaculture for their primary and secondary incomes – 36% started before 1989, 21% in 1997-1999 (mostly small-scale farms), and 43% in 2000-2003 (mostly brackishwater ponds). Most of those currently engaged in aquaculture want to continue in their businesses and seek help from government, researchers, and fellow farmers.

Research publications

AQD researchers continued the tradition of publishing the results of scientific studies, and published 53 scientific papers in journals and books in 2004. As of December 2004, AQD researchers have published about 1,170 scientific papers, 593 in *Current Contents*-covered journals, 198 in local journals, and 379 in proceedings and books. Two AQD Scientists won the Dr. Elvira O. Tan Memorial Awards in 2004 for their publications.



Alava VR, Priolo FMP, Arnaiz M, Toledo JD. 2004. Amino and fatty acid profiles of wild-sourced grouper (*Epinephelus coioides*) broodstock and larvae, pp. 53-54. *In:* Rimmer et al. (2004).

Alava VR, Priolo FMP, Toledo JD, Rodriguez JC, Quinitio GF, Sa-an AC, de la Peña MR, Caturao RC. 2004. Lipid nutrition studies on grouper (*Epinephelus coioides*) larvae, pp. 47-52. *In:* Rimmer et al. (2004).

Amar EC, Lavilla-Pitogo CR. 2004. Nutritional diseases, pp. 59-66. *In:* Nagasawa and Cruz-Lacierda (2004).

Amar EC, Kiron C, Satoh H, Watanabe T. 2004. Enhancement of innate immunity in rainbow trout, *Oncorhynchus mykiss* associated with dietary intake of carotenoids from natural products. Fish Shellfish Immunol. 16: 527-537.

Baticados DB. 2004. Fishing cooperatives' participation in managing nearshore resources: the case in Capiz, central Philippines. Fish. Res. 67: 81-91.

Borlongan IG, Chuan JNP. 2004. Laboratory Manual of Standardized Methods for the Analysis of Pesticide and Antibiotic Residues in Aquaculture Products. SEAFDEC Aquaculture Department, Iloilo, Philippines, 46 pp.

Catacutan MR, Pagador GE. 2004. Partial replacement of fish meal by defatted soybean meal in formulated diets for the mangrove red snapper, *Lutjanus argentimaculatus* (Forsskal 1775). Aquacult. Res. 35: 299-306.

Catap ES, Lio-Po GD. 2004. Fungal diseases, pp. 29-31. *In:* Nagasawa and Cruz-Lacierda (2004).

Coloso RM, Murillo-Gurrea DP, Borlongan IG, Catacutan MR. 2004. Tryptophan requirement of juvenile Asian sea bass *Lates calcarifer*. J. Appl. Ichthyol. 20: 43-47.

Cruz-Lacierda ER, Erazo-Pagador GE. 2004. Parasitic diseases, pp. 33-57. *In:* Nagasawa and Cruz-Lacierda (2004).

Cruz-Lacierda ER, Maeno Y, Pineda AJT, Matey VE. 2004. Mass mortality of hatchery-reared milkfish (*Chanos chanos*) and mangrove red snapper (*Lutjanus argentimaculatus*) caused by *Amyloodinium ocellatum* (Dinoflagellida). Aquaculture 236: 85-94.

Cuvin-Aralar ML, Focken U, Becker K, Ara1ar EV. 2004. Effects of low nitrogen-phosphorous ratios in the phytoplankton community in Laguna de Bay, a shallow eutrophic lake in the Philippines. Aquat. Ecol. 38: 387-401.

Dela Peña LD. 2004. Transboundary shrimp viral diseases, with emphasis on white spot syndrome virus (WSSV) and taura syndrome virus (TSV), pp. 67-69. *In:* Lavilla-Pitogo and Nagasawa (2004).

Dunlap PV, Jiemjit A, Ast JC, Pearce MM, Marques RR, Lavilla-Pitogo CR. 2004. Genomic polymorphism in symbiotic populations of *Photobacterium leiognathi*. Environ. Microbiol. 6: 145-158.

Eguia RV, Romana-Eguia MRR. 2004. Tilapia Farming in Cages and Ponds. Aquaculture Extension Manual No. 36, SEAFDEC Aquaculture Department, Iloilo, Philippines, 40 pp.

Emata AC, Borlongan IG, Garibay ES. 2003. Reproductive performance of the mangrove red snapper, *Lutjanus argentimaculatus*, fed broodstock diet, pp. 55-61. *In:* Ogawa et al. (2003).

Emata AC, Ogata HY, Garibay ES, Furuita H. 2003. Advance broodstock diets and potential for arachidonic acid in reproduction of the mangrove red snapper, *Lutjanus argentimaculatus*. Fish. Physiol. Biochem. 28: 489-491.

Erazo-Pagador GE, Cruz-Lacierda ER. 2004. Environmental diseases, pp. 67-71. *In:* Nagasawa and Cruz-Lacierda (2004).

Eusebio PS, Coloso RM, Mamauag REP. 2004. Apparent digestibility of selected ingredients in diets for juvenile grouper, *Epinephelus coioides* (Hamilton). Aquacult Res. 35: 1261-1269.

Eusebio PS, Coloso RM, Mamauag REP. 2004. Evaluation of some terrestrial proteins in complete diets for grouper (*Epinephelus coioides*) juveniles, pp. 79-84. *In:* Rimmer et al. (2004).

Eusebio PS, Toledo JD, Mamauag REP, Bernas MJB. 2004. Digestive enzyme activity in developing grouper (*Epinephelus coioides*) larvae, pp. 35-40. *In:* Rimmer et al. (2004).

Gapasin RSJ, Polohan BB. 2004. Induction of larval settlement and metamorphosis in the donkey-ear abalone, *Haliotis asinina* Linnaeus by chemical cues. Hydrobiologia 519: 9-17.

Guanzon NG, de Castro-Mallare TR, Lorque FM. 2004. Polyculture of milkfish, *Chanos chanos* (Forsskal) and red seaweed, *Gracilariopsis bailinae* (Zhang et Xia) in brackishwater earthen ponds. Aquacult. Res. 35: 423-431.

Lavilla-Pitogo CR, de la Peña LD. 2004. Diseases of Farmed Mud Crabs *Scylla* spp.: Diagnosis, Prevention, and Control. SEAFDEC Aquaculture Department, Iloilo, Philippines, 89 pp.

Lavilla-Pitogo CR, Nagasawa K. 2004. Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Iloilo, Philippines, 254 pp.

Lavilla-Pitogo CR, Torres PL Jr. 2004. AquaHealth OnLine: a new learning environment for capacity-building in aquatic animal health, pp. 53-66. *In:* Lavilla-Pitogo and Nagasawa (2004).

Lio-Po GD, de la Peña LD. 2004. Viral diseases, pp. 3-18. *In:* Nagasawa and Cruz-Lacierda (2004).

Lio-Po GD, Albright LJ, Traxler GS, Leaño EM. 2003. Horizontal transmission of epizootic ulcerative syndrome (EUS)-associated virus in the snakehead *Ophicephalus striatus* under simulated natural conditions. Dis. Aquat. Org. 57: 213-220.

Luhan MRJ, Tanaka J, Aruga Y. 2003. Tank culture of *Gracilaria heteroclada* (Zhang et Xia). Philipp. Agric. Sci. 86: 355-357.

Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2003. Development of control methods for factors suppressing sustainable production of aquaculture species: experimental transmission of piscine nodavirus-Induced viral nervous necrosis to the orange-spotted grouper *Epinephelus coioides,* pp. 89-94. *In:* Ogawa et al. (2003).

Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2003. Development of control methods of factors suppressing sustainable production of aquaculture species: isolation of piscine nodavirus from hatchery reared sea bass, *Lates calcarifer* in the Philippines, pp. 81-87. *In:* Ogawa et al. (2003).

Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2004. Mass mortalities associated with viral nervous necrosis in hatchery-reared sea bass *Lates calcarifer* in the Philippines. Jpn. Agric. Res. Q. 38: 69-73.

Maluping RP, Lavilla-Pitogo CR, DePaola A, Krovacek K. 2004. Occurrence, characterization, and detection of potential virulence determinants of emerging aquatic bacterial pathogens from the Philippines and Thailand. Microbiologica 27: 381-389.

Millamena OM. 2004. Replacement of fish meal by animal by-product meals in a practical diet for grow-out culture of grouper (*Epinephelus coioides*), pp. 110-112. *In:* Rimmer et al. (2004)

Millamena OM, Toledo JD. 2004. Development of formulated feeds for grow-out culture of grouper (*Epinephelus coioides*) – Tank and field studies, pp. 115-118. *In:* Rimmer et al. (2004).

Minjoyo H, Tan-Fermin JD, Macaranas JM. 2003. Localization of enzymes in the digestive tract during the larval to early juvenile stages of sea bass (*Lates calcarifer* Bloch). Indonesian Fish. Res. J. 9: 46-53.

Moravec F, Cruz-Lacierda ER, Nagasawa K. 2004. *Procamallanus* spp. (Nematoda, Camallanidae) from fishes in the Philippines. Acta Parasitologica 49: 309-318.

Nagasawa K, Cruz-Lacierda ER (eds). 2004. Diseases of Cultured Groupers. SEAFDEC Aquaculture Department, Iloilo, Philippines, 81 pp.

Ogata HY, Emata AC, Garibay ES, Furuita H. 2004. Fatty acid composition of novel aquaculture species in Central Philippines. Aquaculture 236: 361-375.

Ogata HY, Emata AC, Garibay ES, Furuita H. 2003. Notable features of fatty acid composition in mangrove fish species, pp. 63-74. *In:* Ogawa et al. (2003).

Ogawa Y, Ogata HY, Maeno Y, Shimoda T, Fujioka Y, Fukuda Y (eds). 2003. Sustainable Production Systems of Aquatic Animals in Brackish Mangrove Areas. Proceedings of the 2nd Workshop of the JIRCAS International Collaborative Research, 2-3 December 2002, Penang, Malaysia. Japan International Research Center for Agricultural Sciences, Tsukuba.

Peñaflorida YD. 2004. Amino acid profiles in the midgut, ovary, developing eggs and zoea of the mud crab, *Scylla serrata.* Israel J. Aquacult. Bamidgeh 56: 113-125.

Primavera JH. 2003. CRM in the Philippines: seeds of hope, pp. 64-71. *In*: The 3rd Meeting of the Project on Asia Pacific Cooperation for the Sustainable Use of Renewable Resources in Biosphere Reserves and Similarly Managed Areas, 1-6 October 2002, Okinawa, Japan.

Primavera JH. 2004. Philippine mangroves: Status, threats, and sustainable development, pp. 193-207. *In:* Vannucci M (ed) Mangrove Management and Conservation: Present and Future. United Nations University Press, Tokyo.

Pomeroy RS, Agbayani R, Duray M, Toledo J, Quinitio G. 2004. The financial feasibility of small-scale grouper aquaculture in the Philippines.

Primavera JH, Sadaba SB, Lebata MJHL, Altamirano JP. 2004. Handbook of Mangroves in the Philippines – Panay. SEAFDEC Aquaculture Department, Iloilo, Philippines, 106 pp.

Quinitio GF, Sa-an AC, Toledo JD, Tan-Fermin JD. 2004. Changes in gastrointestinal tract and associated organs during early development of the grouper (*Epinephelus coioides*), pp. 26-29. *In:* Rimmer et al. (2004).

Quinitio GF, Sa-an AC, Toledo JD, Tan-Fermin JD. 2004. Localization of enzymes in the digestive system during early development of the grouper (*Epinephelus coioides*), pp. 30-34. *In:* Rimmer et al. (2004).

Quinitio ET. 2003. Mudcrab hatchery and grow-out status in the Philippines, pp. 53-56. *In:* Allan G, Fielder D (eds) Proceedings of the ACIAR Crab Aquaculture Scooping Study and Workshop. ACIAR Working Paper No. 54. Bribie Island, Queensland, Australia.

Rimmer MA, McBride S, Williams KC (eds). 2004). Advances in Grouper Aquaculture. Australian Center for International Agricultural Research, Canberra.

Romana-Eguia MRR, Ikeda M, Basiao ZU, Taniguchi N. 2004. Genetic diversity in farmed Asian Nile and red hybrid tilapia stocks evaluated from microsatellite and mitochondrial DNA analysis. Aquaculture 236: 131-150.

Ruangpan L, Tendencia EA. 2004. Laboratory Manual of Standardized Methods for Antimicrobial Sensitivity Tests for Bacteria Isolated from Aquatic Animals and Environment. SEAFDEC Aquaculture Department, Iloilo, Philippines, 55 pp.

Santiago CB, Gonzal AC, Aralar EV, Arcilla RP. 2004. Effect of stunting of juvenile bighead carp *Aristichthys nobilis* (Richardson) on compensatory growth and reproduction. Aquacult. Res. 35: 836-841.

Santiago CB, Ricci M, Reyes-Lampa A. 2004. Effect of nematode *Panagrellus redivivus* density on growth, survival, feed consumption and carcass composition of bighead carp *Aristichthys nobilis* (Richardson) larvae. J. Appl. Ichthyol. 20: 22-27.

Sumagaysay-Chavoso NS, San Diego-McGlone ML, David LT. (2004). Environmental capacity of receiving water as basis for regulating intensity of milkfish (*Chanos chanos* Forsskal) culture. J. Appl. Ichthyol. 20: 1-13.

Tendencia EA. 2004. Bacterial microbiota of eggs from cage-reared and tank-reared grouper, *Epinephelus coioides.* Bull. Eur. Ass. Fish Pathol. 24: 161-165.

Tendencia EA. 2004. The first report of *Vibrio harveyi* infection in the sea horse *Hippocampus kuda* Bleeker 1852 in the Philippines. Aquacult. Res. 35: 1292-1294.

Tendencia EA, Lavilla-Pitogo CR. 2004. Bacterial diseases, pp. 19-28. *In:* Nagasawa and Cruz-Lacierda (2004).

Tendencia EA, de la Peña MR, Fermin AC, Lio-Po G, Choresca CH Jr., Inui Y. 2004. Antibacterial activity of tilapia *Tilapia hornorum* against *Vibrio harveyi*. Aquaculture 232: 145-152.

Dr. Elvira O. Tan Memorial Awards

JH Primavera
Best Published Paper in Marine Fisheries
Integrated Mangrove-Aquaculture Systems in Asia: Integrated Coastal Zone Management

MR Romana-Eguia
Best Published Paper in Aquaculture
Genetic diversity in farmed Asian Nile and red hybrid tilapia stocks evaluated from microsatellite and mitochondrial DNA analysis

Seminars at AQD by Visiting Scientists

19 February 2004
Fish assemblages of a mangrove estuary in Trang, Thailand
Kuo Ikejima
Asian Institute of Technology, Thailand

14 September
Environmental implications of phosphate consumption by fish: from ecology to molecular biology
Ronaldo Ferraris
Physiology Department, University of Medicine and Dentistry, New Jersey, USA

16 September
Disease control in aquaculture by vaccination
Zilong Tan, Luc Grisez
Intevet Norbio Singapore Pte. Ltd., Singapore

Prevalence of Streptococcus iniae *infection in cultured fish of southeast Asia*
Cedric Komar, Zilong Tan, Annick Bolland, Luc Grisez
Intevet Norbio Singapore Pte. Ltd., Singapore

Toledo JD, Caberoy NB, Quinitio GF. 2004. Environmental factors affecting embryonic development, hatching and survival of early stage larvae of the grouper (*Epinephelus coioides*), pp. 10-16. *In:* Rimmer et al. (2004).

Toledo JD, Chavez D, Rodriguez J Jr. 2004. Studies on semi-intensive seed production of grouper (*Epinephelus coioides*), pp. 55-60. *In:* Rimmer et al. (2004).

Webb EL, Maliao RJ, Siar SV. 2004. Using local perception to evaluate outcomes of protected area management in the Sagay Marine Reserve, Philippines. Environ. Conserv. 31: 138-148.

Mangrove-friendly shrimp farming

Funded by the Government of Japan Trust Fund, the Program included verification and pilot demonstration, research, training, and information dissemination geared at promoting mangrove-friendly shrimp farming. Improved shrimp farming technologies and practices were verified in Thailand, the Philippines, Vietnam, Myanmar, Cambodia, and Malaysia. For example, Thailand established a seawater irrigation system in Kung Krabaen, Chantaburi in order to ensure good water quality for shrimp farming and responsible release of pond effluents to the sea. The effluents from shrimp ponds using the irrigation facility have no adverse effects on the receiving waters and the mangroves in the bay.

Shrimp ponds using the seawater irrigation system in Kung Krabaen Bay

Demonstration of mangrove-friendly shrimp farming in Malaysia and Myanmar

Research has confirmed that mangroves can remove significant amounts of nitrogen and solid wastes from shrimp pond effluents, and that 2-4 hectares of mangroves is required to process effluents from 1 ha of semi-intensive or intensive shrimp pond. Another study confirmed the efficacy of fish as biomanipulators to control luminous bacteria in shrimp ponds. Two studies on the economics of mangrove-friendly shrimp farming in Thailand and in the Philippines are ongoing.

Evaluation of probiotics and waste digesters used in the grow-out of tiger shrimp *Penaeus monodon*

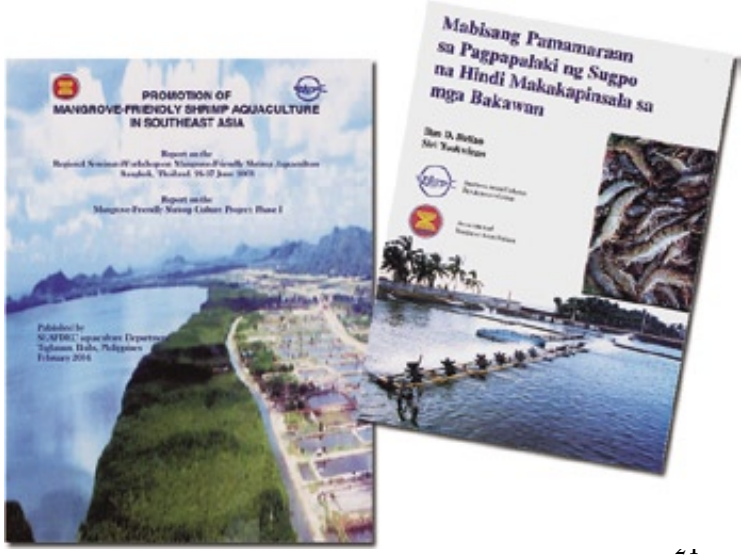
A. Probiotics E, F, G, and H were tested for their effect on the total bacteria count and luminous bacteria count after addition into pond water. Probiotic E increased the total bacterial count from 10^3 to 10^4 after 24 h, but counts gradually dropped to 10^2 towards day 4 and stabilized until day 7. Probiotic F showed a stable total bacterial count at 10^2 to 10^3. Probiotics E and F did not inhibit luminous *Vibrio* after 24 h. Probiotics G and H did not change the total count compared with the controls, where counts dropped 24 h after treatment and remained at 10^2 to 10^3. Probiotic G slightly enhanced the growth of luminous *Vibrio* 4 days after exposure, but *Vibrio* dropped to control levels the next day. Probiotic H reduced the luminous *Vibrio* by day 5-6 and counts were the same as the controls by day 7.

B. Probiotics B, C, E, and I were tested for their effects on nitrite, ammonia, and phosphate, under aerated and non-aerated conditions. With aeration, all test probiotics reduced ammonia and phosphate, and probiotic E significantly removed nitrite. Without aeration, none of the probiotics reduced nitrite, but probiotics B, C, and E reduced the ammonia levels.

C. Probiotics C, D, and F were tested for their effect on uneaten feed. Shrimp feed was added to six 250-liter tanks at amounts based on a stocking density of 30 postlarvae/m^2 and feeding rate of 20-12% for the first 50 days of grow-out. Water temperature and pH, nitrite, ammonia, phosphate, and biochemical oxygen demand (BOD) were measured to determine the effect of uneaten feed on water quality when a probiotic was added or not. Probiotics C, D, and F had no significant effect on poor water quality due to uneaten feeds. The BOD_5 remained at 4-10 ppm in the presence of probiotic C, 3-7 ppm with D, and 4-6 ppm with F.

Further training in mangrove-friendly shrimp farming was conducted under the Program in 2004, including a third formal course at AQD Tigbauan, on-site training in Vietnam and Cambodia, and skills development sessions at the verification sites. The formal course at AQD from 21 Oct to 9 Nov had nine participants from Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam. The on-site training in Binh Dinh, Vietnam from 30 Nov to 6 Dec had 58 participants comprising technicians, fishery biologists, aquaculture extension workers, and private sector representatives, with resource persons provided by the Department of Fisheries Thailand. The on-site training in Sihanoukville, Cambodia on 13-17 December had 25 participants and resource persons provided by AQD and the Department of Fisheries Thailand.

The Program released in February 2004 the program document, *Promotion of Mangrove-Friendly Shrimp Aquaculture in Southeast Asia*, containing the Report on the Mangrove-Friendly Shrimp Culture Program as of June 2003, and the Report on the Regional Seminar-Workshop on Mangrove-Friendly Shrimp Aquaculture, Bangkok, Thailand, 24-27 June 2003. The Filipino-language version of the extension manual, *Best Management Practices for Mangrove-Friendly Shrimp Farming* by DD Baliao and S Tookwinas was published in December 2004. The other translations into Bahasa Indonesia, Burmese, Vietnamese, Khmer, and Thai are in progress.



The Regional Technical Consultation in Bohol, Philippines on 25-27 August, produced a Code of Practice for the Sustainable Use of Mangroves in Aquaculture

The Regional Technical Consultation for the Development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems was convened by AQD in Tagbilaran, Bohol, Philippines on 25-27 August. It was attended by 40 representatives from the SEAFDEC-ASEAN Member Countries, and from AQD, UNESCO, JIRCAS, and non-government organizations. A first draft of the Code of Practice was prepared by AQD based on international and regional guidelines related to mangroves and sustainable aquaculture. The RTC discussed and revised the first draft and adopted a draft *Code of Practice for the Sustainable Use of Mangroves in Aquaculture* to be discussed with their respective governments and stakeholders. After the RTC, the participants toured the island of Bohol, including the mangrove plantation in Banacon Island, the Chocolate Hills, the man-made forest in Bilar, Loboc River, and Panglao Island. Bohol still has considerable areas of mangroves, and everywhere there was evidence of use of mangroves for livelihood, including fisheries and tourism.

Banacon Island residents grow seaweeds among the mangroves

Mangrove areas and the adjoining seagrass beds yield crabs that provide livelihood to island residents

SEAFDEC Deputy Sec-Gen Junichiro Okamoto meets the tarsiers of Bohol

Regional Fish Diseases Program

Funded by the Government of Japan Trust Fund, the Regional Fish Disease Program aims to establish a disease control system in aquaculture and help ensure that only healthy and wholesome aquaculture products, including hatchery-bred seed, are traded in Southeast Asia. AQD hosts the Program, but implementors include the Aquatic Animal Health Research Institute (Thailand), the Samut Chakhorn Coastal Aquaculture Development Center (Thailand), the SEAFDEC Marine Fisheries Research Department (Singapore), and the Fish Health Research Laboratory (Indonesia).

In 2004, the Program focused more on viral diseases in aquaculture, particularly white-spot syndrome virus (WSSV) in crustaceans, viral nervous necrosis (VNN) in carnivorous fishes, and koi herpesvirus (KHV) in common carp. The results of AQD research in 2004 are summarized in the next two pages. There is also ongoing research in Indonesia to develop vaccines against KHV, using inactivated virus or recombinant viral envelope protein. AQD scientists conducted field surveys in Indonesia in April and in Taiwan in July 2004. AQD and FHRL researchers collected samples of KHV from diseased fish from Cirata Reservoir in west Java. It has been agreed earlier that as soon as new information on KHV infection is reported in the SEAFDEC Member Countries, AQD will dispatch a fish health team to the disease sites in order to diagnose the disease together with scientists of the affected country.

Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia, Manila, 23-24 June 2004

KHV is the newest viral disease that has caused mass mortalities of affected common carp, or koi *Cyprinus carpio.* Common carp is important food fish in rural Southeast Asia, farmed in large volumes especially in Indonesia. The ornamental variety of koi is widely traded around the world. KHV was first reported in Israel and the United States in 2000. The first outbreak in Asia occurred in Indonesia in March 2002, and has since then spread throughout the country. It is thought that KHV was brought to Indonesia with koi imported from Hong Kong. In October 2003, KHV outbreaks occurred in Japan.

With the alarming spread of KHV in Asia, strategies for its prevention and control had to be initiated. Thus was organized the International Symposium on Koi Herpesvirus Disease by joint effort of SEAFDEC, the Fisheries Research Agency of Japan, the Ministry of Agriculture, Forestry and Fisheries of Japan, and the Office International des Epizooties. Held in Yokohama, Japan on 13 March 2004, the symposium was attended by scientists from Japan, SEAFDEC Member countries, United States, East Asia, Israel, and Europe to exchange the latest information on KHV and its prevention and control. Prof. RP Hedrick of the University of California-Davis, the foremost expert on KHV, gave the keynote lecture. Fifteen other talks were given. Program Leader Dr. Kazuya Nagasawa presented the KHV research to be done by AQD.

The Regional Fish Disease Program subsequently convened in Manila, Philippines on 23-24 June the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. Participants included scientists from the 11 SEAFDEC Member Countries, two invited speakers from Taiwan and Canada, 10 AQD scientists, and two scientists each from the Office International des Epizooties and the Network of Aquaculture Centres in Asia-Pacific. The meeting provided a forum for SEAFDEC Member Countries to share experiences and knowledge of transboundary fish diseases and pathogens, discussed the status of fish disease quarantine, surveillance, monitoring, diagnosis, research, and training in the Member Countries, and identified the issues and problems to be solved at the national and regional or international levels.

Bacteria as biological control agent against microbial diseases in shrimp and mud crab hatcheries. The effects of strain C1 bacteria and of salinity on the motility of fungal zoospores were tested. Motile zoospores of the fungus *Lagenidium* sp. were transferred into 10^5 and 10^6 cfu/ml C1 suspensions, and into 15-16 ppt and 7-8 ppt seawater. The zoospores became immobile after 10-15 minutes in 7-16 ppt water, but not those in the C1 bacterial suspensions.

Effect of rabbitfish rearing water on luminous bacteria. Concrete tanks with 3 tons microfiltered water (24 ppt) were stocked with *Penaeus monodon* (80 g/m^3), with or without the rabbitfish *Siganus guttatus* (500 g/m^3). Six hours after stocking, the water was inoculated with *Vibrio harveyi* to an initial concentration of 10^3 cfu/ml. Counts of luminous bacteria were found lower in tanks with tiger shrimp and rabbitfish, significantly so from day 4 to 19 when luminous bacteria fell to 1-20 cfu/ml.

Immunological indices for monitoring health status in *Penaeus monodon*. Hemocyte responses to β-glucan, *Vibrio harveyi*, and white spot syndrome virus (WSSV) were tested as indicators of health status in tiger shrimp. The parameters included total hemocyte count (THC), differential count, phenoloxidase activity (PO), plasma bactericidal activity, and lymphoid organ (LO) histopathology. Responses to β-glucan and *Vibrio harveyi* were similar in most respects but basically different from the response to WSSV. In *Vibrio*- and β-glucan-exposed groups, progressive changes occurred ranging from minimal cell vacuolation to complete degradation of the tubule and spheroid cells. In the WSSV-exposed shrimp. various stages of apoptotic cells commonly occurred. THC and PO activity were found to be the most sensitive indicators.

Antibacterial metabolites in 'green water'. Viability test of the indigenous probiotic bacteria showed that these remained viable and stable in pond waters for >45 days. The indigenous probiotic showed stable growth in nutrient broth and in 0.1% and 0.5% fish meal suspensions, reaching populations of 10^7-10^8 cfu/ml after 24 h. In rice bran solutions, poor growth yielded bacterial population of only 10^1-10^5 cfu/ml.

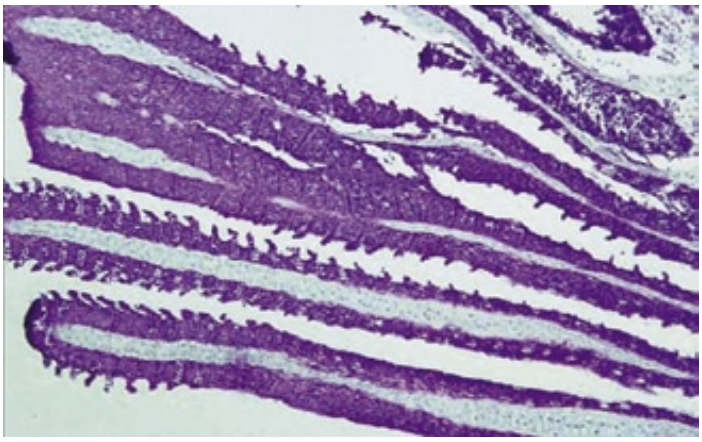
Prevalence of viral diseases in farmed and wild shrimps in the Philippines. Extraction of nucleic acids from the existing wild shrimp samples and optimization of other PCR protocols are ongoing. Additional samples of wild and farmed shrimps are being obtained.

Parasitosis in marine and freshwater fishes. Regular monthly screening for parasites was done for pond-reared mangrove red snapper *Lutjanus argentimaculatus* (n=96) and rabbitfish *Siganus guttatus* (n=83) and freshwater catfish *Clarias macrocephalus* (n=63). In addition, 32 species of fish or a total of 195 specimens, bought from the market or caught from water supply canals, inside brackishwater ponds, or near floating cages were found to have similar parasite fauna. This result indicates that wild fish are potential reservoirs of parasites that infest farmed fish. The parasites recovered included the protozoans *Trichodina* spp. and *Vorticella*, the monogeneans *Haliotrema* spp. and *Gyrodactylus,* and four species of copepods from the body surface and gill filaments. The dinoflagellate *Amyloodinium ocellatum*, in high numbers on the body surface and gills, caused high mortality in hatchery-reared snapper and rabbitfish.

Preventive measures against viral nervous necrosis (VNN) in fish broodstocks. To screen grouper broodstock for VNN, 20 females (6 kg BW) and 12 males (11 kg BW) were sampled for eggs, milt, gills, and blood. Direct PCR assays and combination of cell culture (using E-11) and PCR assays were done. Of the 32 fish, 19 were found positive and 13 negative for VN after nested PCR by the combination method. The detection rate of cell culture and PCR combination (44%) is higher than the direct PCR method after the nested step (19%). Pre-spawning screening for VNN of other broodstocks at AQD showed the following percentage of VNN-positive fish: *E. fuscoguttatus* 56%, seabass *Lates calcarifer* 25%, and snapper *Lutjanus argentimaculatus* 38%. The VNN-positive fish were stocked in separate tanks from the VNN-negative ones. Post-spawning sampling of 13 VNN-negative grouper broodstocks showed all to be positive after nested PCR. The virus was eliminated from the eggs of VNN-positive broodstocks by disinfection with 5 ppm and 7 ppm iodine prepared from 10% stock solution.

VNN in wild and farmed fish in the Philippines. 'Trash' fish species used as feed for the broodstock were earlier found to be VNN-positive. Thus, a systematic sampling was done every two months at the Iloilo Fishing Port, and 21 species were collected over five samplings. During the first sampling, two species (bulaw and sapsap) out of 9 were found positive for VNN by nested PCR. The second sampling showed that of 14 species, three were VNN-positive (dubla-dubla, hasa-hasa, and karaho) by RT-PCR, and 70-100% were positive after nested PCR. In later samplings, 11, 17, and 18 species were screened, and all were negative after RT-PCR, but positive after nested PCR, except dalinu-an in the 5th sampling. The results indicate that 'trash' fish is a major source of VNN contamination of the broodstocks. VNN from 'trash' fish was isolated using the E-11 cell line to determine whether the virus is viable.

Detection and identification of viral pathogens in groupers and sea bass. Confirmatory passage of viral isolates through cell culture assays was continued. The cell lines E-11, SBK-2, GF, EPC, FHM, SSN-1 were maintained, and a new cell line, KF-1, was obtained from RP Hedrick.



Gill filaments of KHV-infected common carp: severe hyperplasia and fusion of adjacent lamellae

AQD and FHRL researchers collect samples of KHV from diseased common carp from Cirata Reservoir, West Java, Indonesia

Histopathology of koi herpesvirus (KHV) disease. Live common carp *Cyprinus carpio* (59-112 mm) were sampled from KHV-infected farms in Cirata Reservoir, Jakarta, Indonesia. Tissues of 5 fish were dissected and fixed on site in 10% buffered formalin for light microscopy and in 2.5% glutaraldehyde for transmission electron microscopy. The other 5 fish were transported live and processed in the laboratory. Five fish (130-165 mm, 32-63 g) from the cohabitation experiment of Dr. Agus Sunarto were also processed for histopathology. All samples from Cirata appeared healthy and active. Gill tissues were pale blackish-brown with necrotic filament tips. Fixed gill tissues had white spherical parasites within the lamellae. The liver of some fish looked pale. Changes in the gill tissues of fish from Cirata included hyperplasia of the epithelial cells of secondary lamellae. Several parasite cysts, most likely ciliates, and monogeneans were lodged within the lamellae. Severe hyperplasia caused fusion of adjacent lamellae. Fish from the cohabitation experiment had the same gross changes as the Cirata samples.

Hematology of koi *Cyprinus carpio* infected with KHV. Koi was experimentally infected with koi herpesvirus and the changes in hematological and plasma chemistry parameters were measured. Five fish (10g) were stocked in duplicate glass aquaria containing 15 liters of UV-filtered water and provided with adequate aeration. The fish were injected intraperitoneally at a dose of 100 µl per fish with undiluted supernatants from KF-1 cell line. Control fish were injected with virus-free culture media. Fish were sampled at 0, 1, 3, 6, 9, and 11 days post-infection. Infected fish started dying on day 8 and all died by day 11. No mortality was recorded in the control group until the experiment ended on day 20.

Hemoglobin and the percentage of neutrophils were higher, but the platelet count was lower in the control group during the incubation period. At onset or peak of mortality, the infected group had higher hematocrit, hemoglobin, and percentage of neutrophils but lower RBC, platelet count, total protein, albumin, and Mg. Changes in the hematology and plasma chemistry may be useful in the diagnosis of KHV infection.

Virucidal effect of various disinfectants on KHV. Cell line KF-1 and KHV virus obtained from the United Kingdom (Malaysian strain) were propagated.

Transmission and control of KHV. Cell lines E-11, GF-1, SNN-1, FHM, EPC, WSSK, WSSC1, BF-2 are being maintained. The KF-1 cells and CCF cells were obtained from M Sano in March and December 2004. Sampling of KHV-suspected common carp was conducted in Cirata, Taipei, and Vietnam in April, July, and December 2004. Tissue filtrates of carp from Indonesia and Taiwan did not induce cytopathic effects when inoculated into KF-l cells. Intraperitoneal injection of the tissue filtrates to healthy carp also did not induce any pathological signs or mortality.

Isolates of KHV from Japan, USA, United Kingdom (Malaysian strain) were obtained from M Sano, R Hedrick, and K Way. Propagation of these KHV isolates in KF-1 is ongoing. The Malaysian strain of KHV was inoculated into healthy common carp by intraperitoneal injection and by bath. Injected carp died on day 6 or day 10; bath-treated fish died on day 16-17. Filtrates from dying and freshly dead infected fish when re-injected into healthy carp likewise caused mortality.

PCR-based detection method and phylogenetic analysis of KHV isolates from Asian countries. Suspected KHV-infected fish samples were collected from the Philippines, Indonesia, Taiwan, and Vietnam, fixed in 95% ethanol, and stored at 4°C until use. Cell line infected with KHV (obtained from R Hedrick) was used as positive control. DNAzol was used to extract the DNA, and the PCR protocol was optimized to detect KHV. The amplified products will be sequenced.

Comparison of characteristics of KHV isolates from Asia. Primary virus isolation was done with the tissue filtrates from fish samples from Vietnam. No cytopathic effects were detected in inoculated KF-1 cells. The injected fish did not manifest any pathological signs nor mortality. Viability assays showed that the Malaysian strain of KHV remained viable at –80°C for 30 days. At 0–15°C, the KHV isolate continued to replicate in the KF-1 cells until day 5. The virus died in 3 days when stored at 20-30°C and in one day at 35°C.

The third session of AquaHealth Online, AQD's distance-learning course on the Principles of Health Management in Aquaculture, was conducted from 2 August to 17 December. The course used a new e-learning system installed by AQD's Webmaster SR Tillo Jr. The 25 participants included 19 from the SEAFDEC-ASEAN Member Countries sponsored by the Regional Fish Diseases Program and the Integrated Regional Aquaculture Program. One was sent by the Network of Aquaculture Centres in the Asia-Pacific, another by BFAR Region 7, and four were from the private sector.

The course included 12 modules taught by AQD Specialists and the participants were graded for learning activities (20%), discussion board participation (20%), and exams (60%). The passing grade was set at 70% and 15 of the 25 e-learners passed the course. Veterinarian Tom Cuyos from BFAR Region 7 topped the class. The best e-learners will be invited to AQD in 2005 for the classroom and laboratory version of the AquaHealth course.

In addition to the online course, hands-on training in fish health management, particularly the detection of viruses by polymerase chain reaction (PCR) assay was provided by AQD's Fish Health Specialists. In March and April, three laboratory technicians from the private sector trained in the PCR technique for detection of white spot syndrome virus at AQD's Disease Diagnosis Lab under the supervision of LD de la Peña. In October, ten laboratory technicians from the Bureau of Fisheries and Aquatic Resources trained in the PCR technique for the detection of koi herpesvirus. In November, nine Veterinary Medicine students from Aklan State University got on-the-job training at the Fish Health laboratories, plus free classes about various aspects of fish health management.

The Program produced five research-based books and proceedings in 2004:

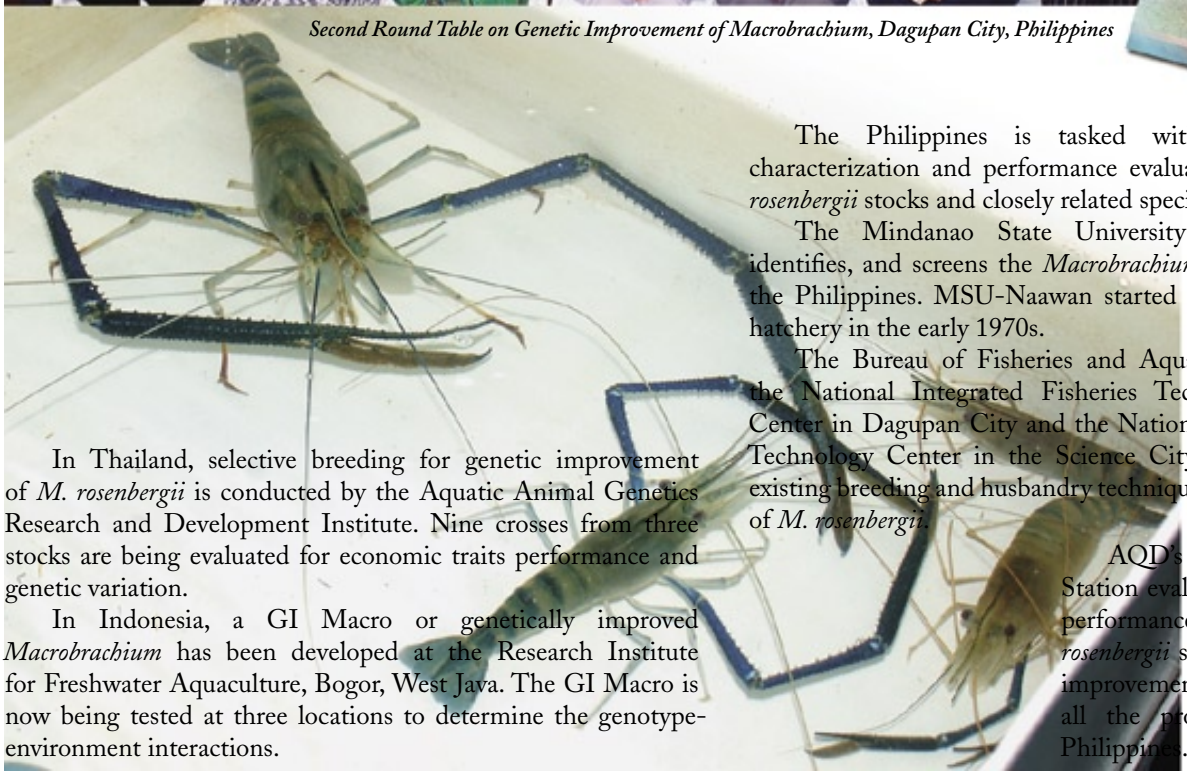
- *Laboratory Manual of Standardized Methods for the Analysis of Pesticide and Antibiotic Residues in Aquaculture Products*
  IG Borlongan and JNP Chuan
- *Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training*
  Edited by CR Lavilla-Pitogo and K Nagasawa
- *Diseases of Farmed Mud Crabs Scylla spp.: Diagnosis, Prevention, and Control*
  CR Lavilla-Pitogo and LD de la Peña
- *Laboratory Manual of Standardized Methods for Antimicrobial Sensitivity Tests for Bacteria Isolated from Aquatic Animals and Environment*
  L Ruangpan and EA Tendencia
- *Diseases of Cultured Groupers*
  Edited by K Nagasawa and ER Cruz-Lacierda

The special training for BFAR personnel on KHV detection by PCR assay

Integrated Regional Aquaculture Program

This Program included a variety of projects and activities according to the needs of the Member Countries, as identified during the Program Committee Meeting, and the site surveys conducted by AQD in 2003. Many of the requests were for training in seed production and rural aquaculture. IRAP funded two projects to verify hatchery technologies for marine fishes. SEAFDEC/AQD, Indonesia, Thailand, and the Philippines also agreed to collaborate in research to improve the genetic characteristics of the giant freshwater prawn *Macrobrachium rosenbergii* and produce quality seedstock for farming. The specific responsibilities of the three countries were established during the First Round Table Discussion on the Development of Genetically Improved Strain of *Macrobrachium* held Sukabumi, Indonesia in November 2003. The Second Round Table, held in Dagupan City and Muñoz City, Philippines from 16 to 21 September 2004 confirmed the responsibilities of the participating countries, assessed the progress of the collaborative research, identified the problems encountered in the implementation, and recommended the future course of action.

Second Round Table on Genetic Improvement of Macrobrachium, Dagupan City, Philippines



In Thailand, selective breeding for genetic improvement of *M. rosenbergii* is conducted by the Aquatic Animal Genetics Research and Development Institute. Nine crosses from three stocks are being evaluated for economic traits performance and genetic variation.

In Indonesia, a GI Macro or genetically improved *Macrobrachium* has been developed at the Research Institute for Freshwater Aquaculture, Bogor, West Java. The GI Macro is now being tested at three locations to determine the genotype-environment interactions.

The Philippines is tasked with the morphometric characterization and performance evaluation of *Macrobrachium rosenbergii* stocks and closely related species.

The Mindanao State University in Naawan collects, identifies, and screens the *Macrobrachium* samples from around the Philippines. MSU-Naawan started work on *M. rosenbergii* hatchery in the early 1970s.

The Bureau of Fisheries and Aquatic Resources through the National Integrated Fisheries Technology Development Center in Dagupan City and the National Freshwater Fisheries Technology Center in the Science City of Muñoz refine the existing breeding and husbandry techniques for the domestication of *M. rosenbergii*.

AQD's Binangonan Freshwater Station evaluates and compares the performance traits of different *M. rosenbergii* stocks for use in genetic improvement; BFS also coordinates all the project activities in the Philippines.

The giant freshwater prawn is native to tropical countries in South and Southeast Asia, parts of Oceania and the Pacific. The Philippine stock of *Macrobrachium rosenbergii* is an eastern subspecies (*M. rosenbergii rosenbergii* De Man 1895) different from the western subspecies (*M. rosenbergii dacqueti* Sunier 1925) found in India, Thailand, Malaysia and some parts of Indonesia. The plan is to collect wild stocks of *Macrobrachium rosenbergii* from different localities in the Philippines. These and existing hatchery stocks of *M. rosenbergii* maintained at BFAR Dagupan and BFAR Munoz, as well as other indigenous *Macrobrachium* species will be characterized through morphometric analysis in collaboration with taxonomists from the National University of Singapore (Dr. Peter Ng and Dr. Daisy Wowor).

Collection, identification and validation of *Macrobrachium* samples. Several juveniles and adults of *Macrobrachium rosenbergii* were collected from Calumpit River in Bulacan and preserved in 80% ethanol for identification. Based on the shape of the rostrum, body color, and pattern, the samples from Calumpit were identified as *Macrobrachium rosenbergii rosenbergii* and *Macrobrachium rosenbergii dacqueti*. The rostrum of *M. r. rosenbergii* has a lower basal crest than *M. r. dacqueti*. Samples collected by H Dejarme from Dinas and Siay in Mindanao were all *M. rosenbergii;* those from Tambulig town comprised of *M. rosenbergii*, *M. equidens,* and *M. mamillodactylus*.

Evaluation of reproductive performance of prawn fed low-protein and high-protein diets. Spawning groups of *Macrobrachium rosenbergii sp.* from a hatchery stock (BFAR strain) and a wild stock (Calumpit strain) were stocked in outdoor concrete tanks in August and in October, respectively. Stocks were fed either a low-protein diet (commercial fish feed), or high-protein diet (prawn feed), *ad libitum* or at 2% of the prawn biomass. The BFAR stock spawned more frequently than the Calumpit stock, regardless of the type of feed. Larvae from the wild Calumpit stock survived poorly, but were larger than those of the BFAR stock. Refinements are being made to increase the survival of larvae from the wild stock.

Evaluation of growth of two strains of *Macrobrachium rosenbergii* in cages in Laguna de Bay. Two stocks of *M. rosenbergii* (CAL, progeny of the native strain from Calumpit, Bulacan and BFAR, progeny of the strain from BFAR, originally from Thailand) were reared in net cages in Laguna de Bay. Initial stocking size was 0.02 g for CAL and 0.3 g for BFAR. The prawn were stocked initially at 225 larvae/m². After a month, the CAL prawn had a mean weight gain of 0.52 g, the BFAR prawn, 0.64 g. They were transferred to cages at a lower stocking density of 15/m². After the second month, the CAL prawn gained 2.1 g, and BFAR prawn gained 2.2 g. The prawns relied solely on natural food available in the lake. Survival of the two stocks was 85% after two months.

The Macrobrachium facilities of BFAR's National Integrated Fisheries Technology Development Center in Dagupan City

To promote information dissemination, IRAP funded the participation of AQD in AquaLink 2004 held in Manila on 22- 23 April and sponsored the AQD booth during the Sixth International Symposium of Tilapia in Aquaculture on 12-16 September. IRAP also funded the printing of the *Report of the First Round Table Discussion on the Development of Genetically Improved Strain of Macrobrachium*, the annual report *2003 AQD Highlights*, the manual *Tilapia Farming in Cages and Ponds*, and the 2005 calendar about the three regional programs implemented by AQD under the ASEAN-SEAFDEC Fisheries Consultative Group.

Two fisheries officers from Brunei Darussalam train in Macrobrachium farming in Surat Thani, Thailand

In 2004, IRAP sponsored many types of training activities around the region. SEAFDEC/AQD facilitated the attachment training of two fisheries officers from Brunei Darussalam in the hatchery and grow-out of *Macrobrachium rosenbergii* at the Surat Thani Inland Fisheries Research and Development Center, Thailand, from 13 Sep to 9 Oct 2004. The training aimed at transferring the Thai farming technology for *M. rosenbergii* to Brunei Darussalam. The training included lectures, discussions, visits to farms, laboratory work, propagation of natural food, and cleaning of tanks. Surat Thani provided the resource persons.

Three on-site training sessions were conducted under IRAP in 2004. On-site training was conducted in Jambi, Sumatra, Indonesia on 13-17 April to improve farming techniques for patin, or the catfish *Pangasius djambi* so that rural fish farmers may be able to increase production and income. The on-site training was coordinated by Mr. Anto Sunaryanto of the Directorate General of Aquaculture, concurrently the SEAFDEC National Coordinator for Indonesia, and Mr. Maskur, the IRAP Technical Lead Person for Aquaculture for Rural Development in Indonesia. Mr. Naruepon Sukumasavin of the Department of Fisheries of Thailand served as the Resource Person for the on-site training. Under the cost-sharing scheme, IRAP provided the Resource Person, and Indonesia paid for all the local expenses. One training session was held in Lopak Allai Village for 17 local fish farmers and five fisheries officers of Muaro Jambi District Office; another session was conducted at Tangkit Baru Village for 20 participants from the Mina Sukses Farmer Association.

IRAP also facilitated the on-site training of 34 technicians and farmers in *Babylonia* and abalone farming in Rayong, Thailand on 27-30 September. The training aimed to promote the farming of babylonia and abalone as alternative sources of protein and livelihood in rural coastal areas. The trainors came from the Research Institute for Aquaculture of the Ministry of Fisheries Vietnam and from the Rayong Coastal Fisheries Research and Development Center of the Department of Fisheries Thailand. Moreover, AQD conducted on-site training in rabbitfish seed production in Hue City, Vietnam on 19-24 November for 12 participants.

The training courses at SEAFDEC/AQD were made available to 15 government fisheries officers and technicians from the Member Countries with funding from IRAP. A Vietnamese took the training course in marine fish hatchery and nursery in June. Three trainees from Myanmar, Vietnam, and Cambodia participated in the mudcrab hatchery and nursery course in September. An Indonesian attended the training in abalone hatchery and grow-out in November. Nine participants in the distance learning course *AquaHealth Online* were also sponsored by IRAP.

On-site training on patin farming in Jambi, Sumatra, Indonesia

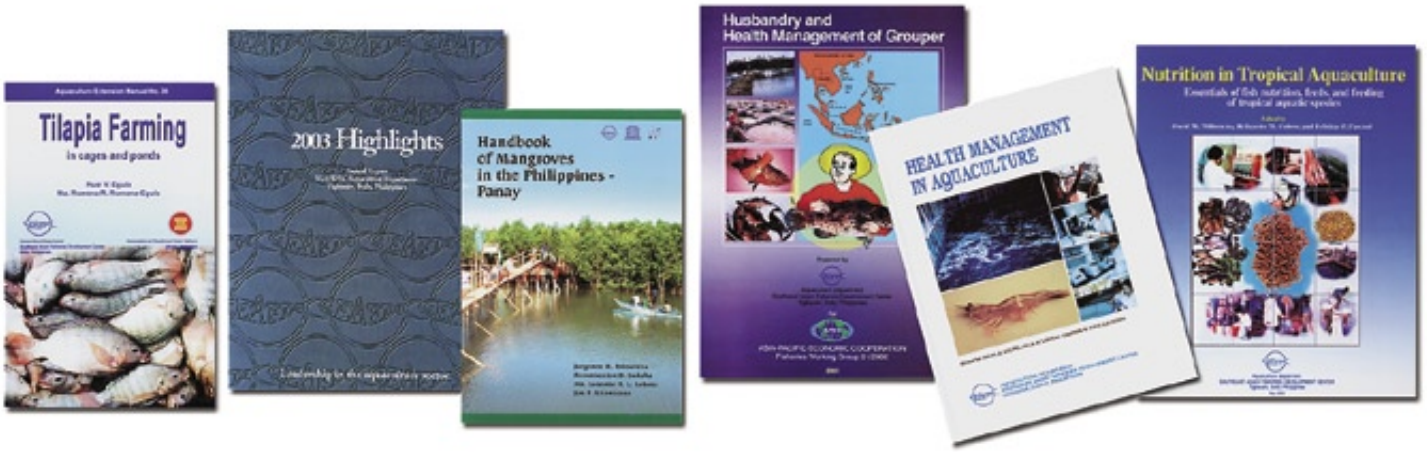
On-site training in babylonia and abalone farming, Rayong, Thailand

On-site training in rabbitfish hatchery in Hue, Vietnam

Marine fish hatchery training at AQD Tigbauan

Information dissemination

AQD actively produces information about aquaculture science and technology in a variety of formats and makes them widely available to researchers and technologists, students and teachers, farmers and technicians, managers and entrepreneurs, regulators and policy-makers. In 2004, AQD co-published the book the *Handbook of Mangroves of the Philippines–Panay* with the United Nations Educational Scientific and Cultural Organization. AQD also published five books written by AQD researchers under the Regional Fish Diseases Program. Aquaculture Extension Manual 36, *Tilapia Farming in Cages and Ponds,* was published on the occasion of the Sixth International Symposium on Tilapia in Aquaculture. AQD's annual report, the *2003 Highlights* was released in April. The newsletter *SEAFDEC Asian Aquaculture* was not published in 2004 for lack of a production team. The internal newsletter was renamed *AQD Matters* and released monthly through email. AQD also maintains two websites, www.seafdec.org.ph and www.mangroveweb.net and hosts the website of the Fish Health Section of the Asian Fisheries Society at www.afs-fhs.seafdec.org.ph. The AQD Library is still the best aquaculture library in the Philippines and Southeast Asia.



AQD Bookstore

The AQD Bookstore at the Training and Information Building has been revitalized this year. Total sales of AQD books, manuals, videos, and CDs from January to 31 December was PhP 408,954 (all titles). Sales included those made at Tigbauan Main Station, Manila Office, Binangonan Freshwater Station, and at the conferences and exhibitions that AQD participated in.

Two textbooks and a monograph authored by AQD scientists won three Outstanding Book Awards 2004 from the National Academy of Science and Technology of the Philippines.

Husbandry and Health Management of Grouper (2000)
EC Lacierda, CR Lavilla, JD Toledo, NJ Ogburn, NV Golez

Health Management in Aquaculture (2001)
Editors: GD Lio-Po, CR Lavilla, ER Cruz-Lacierda

Nutrition in Tropical Aquaculture (2002)
Editors: OM Millamena, RM Coloso, FP Pascual (2002)

The monograph on grouper health was prepared by AQD for the Asia-Pacific Economic Cooperation (APEC) Fisheries Working Group and has been translated into several languages used in southeast Asia. The two textbooks on health management and on nutrition were written based on lectures and laboratory practicals given during the training courses conducted at AQD yearly over so many years. They are the first two books finished under the Textbook Writing Project initiated by AQD Chief RR Platon and implemented by the Training and Information Division under TID Heads RF Agbayani and Engr PL Torres Jr. These textbooks are now used by fisheries schools in the Philippines.

During its 31st anniversary on 9 July 2004, AQD launched four new publications: the *Handbook of Mangroves of the Philippines – Panay* by JH Primavera and coauthors, the extension manual *Best Management Practices for Mangrove-Friendly Shrimp Farming* by DD Baliao and S Tookwinas, the *Laboratory Manual of Standardized Methods for the Analysis of Pesticide and Antibiotic Residues in Aquaculture Products* by IG Borlongan and JN Chuan, and the *Proceedings of the Shrimp Congress 2002*. Complimentary copies of these were given out to representatives of government, academe, and the industry. Fish farmers who were earlier invited over the radio were given 100 free aquaculture manuals, and libraries from around Panay Island were given 50 free AQD books.

AQD participated in three aquaculture-related congresses and exhibitions – the Shrimp Congress 2004 in Cebu from 30 March to 1 April, AquaLink 2004 in Manila on 21-23 April, and the Sixth International Symposium on Tilapia in Aquaculture on 12-16 September.

AQD also convened several of its own Regional Technical Consultations and scientific meetings (see Regional Programs) to exchange information and research results. During the Second Round Table Discussion on *Macrobrachium* Genetic Improvement, the extension manual *Tilapia Farming in Cages and Ponds* was launched by author Ma. Rowena Romana-Eguia, in the presence of Dr. Kevin Fitzsimmons of the World Aquaculture Society.

Book launching during AQD's 31st anniversary on 9 July

AQD gave away free copies of books and manuals on 9 July

700AQD
Aqua info at your thumbs

Fish farmers, students, teachers, researchers, and other interested persons can now have aquaculture information at their thumb tips anytime. SEAFDEC AQD launched on 9 July 700AQD, a texting service through Smart and Talk n' Text mobile phones.

How 700AQD works:

With your mobile phone, write message INFO <KEYWORD> and send to 700AQD (or 700273). The first-level keywords are ANALYSIS, BOOKS, CONTACTS, DIAGNOSTICS, EVENTS, FRY, HELP, LIVEFEED, PRICE, STATS, TRAINING, WHATSNEW. The phone calls back with menus of second-level keywords and related information. For example, if you write message INFO TRAINING CRAB and then send to 700AQD, the inbox will show a message regarding the schedule for the crab training course.

Tilapia Farming in Ponds and Cages was launched by author Ma. Rowena Romana-Eguia on 17 September

AQD's information booths during the Sixth International Symposium of Tilapia in Aquaculture and during AquaLink 2004

AQD Library

The AQD Library's present collection, based on the accession book, stands at 17,757 monographs, 4,000 SEAFDEC publications, 7,844 bound serial volumes, 9,102 pamphlets, and a variety of maps, posters, microfiche and CD-ROMs. Only five books were purchased and 86 issues from serial subscriptions were received during the period. Subscriptions to four journal titles in aquatic animal health were paid for by the Fish Diseases Project (Dr. Kazuya Nagasawa) funded by the Government of Japan Trust Fund. Renewal subscription to 2004 Aquaculture Elsevier was paid last December. Some 460 journal titles and 506 issues or volumes were received from different libraries and institutions as gifts or in exchange for AQD publications. Ten researchers who resigned deposited a large number of reference materials at the library. About 650 news items on science, special features, and press releases on SEAFDEC/AQD were cut out from newspapers and posted in the bulletin board and the library's local area network.

A more complete inventory of the AQD Library's collections is found in the Follett database, which includes 32,986 titles and 50,866 volumes/copies as of December 23, 2004. Data encoding, barcoding, and updating of library materials in the Follet database is ongoing. The Follet database is available for use at the Library, through the internet via online public access (OPAC) at the AQD website, and also through the library local area network.

The AQD Library maintains CD-ROM copies of Aquatic Science and Fisheries Abstracts (www.silverplatter.com), Fish and Fisheries Worldwide, Aquatic Biology and Fisheries Resources (www.nisc.com), Current Contents–Agriculture, Biology and Environmental Science and Life Sciences (www.isinet.com), ReefBase, FishBase and FishStat (FAO, www.fao.org).

The AQD Library maintains linkages and exchanges AQD publications with international organizations, universities and research institutions, government agencies, libraries, and some eminent individuals. The Library's Gifts and Exchange mailing list has not been served this year due to lack of funds. Some 100 extension manuals and 50 books were given out free to farmers and librarians during the 31st AQD anniversary.

Work at the Library includes a continuous process of recording and documenting newly arrived materials. First is the accessioning, when a unique number is assigned to a newly arrived document and the details of ordering and receipt are recorded. During the period, 351 titles (504 volumes) were accessioned and 533 titles (632 volumes) were catalogued. Next the document is catalogued and classified according to the Library of Congress Subject Headings, ASFA Thesaurus, Library of Congress Classification Scheme, and the Cutter Table. In cataloguing documents, bibliographic information is prepared about it. Then a bar code label is assigned to each book for encoding in the library database. The bar codes are attached to the library materials as unique identification numbers for inventory purposes. The bar codes are in MARC (machine-readable cataloguing) format, i.e., the computers can read and manipulate the labels.

FishWorld

FishWorld is AQD's visitor center and public education center. For a P10-20 entrance fee, visitors are allowed unlimited time at FishWorld to examine the poster exhibits about fisheries and aquaculture, the aquarium exhibits, and the Museum of Aquatic Biodiversity. Visitors are also shown a video about SEAFDEC and AQD and may be taken on a guided tour of the AQD hatcheries and laboratories. July is open house every year in celebration of the AQD anniversary. The FishWorld Sea Store sells AQD extension manuals, T-shirts, and a variety of fish-inspired souvenir items.

Filipinos should become aware of the country's biodiversity, take pride in it, and become stewards of it. FishWorld promotes such public awareness through the Museum of Aquatic Biodiversity, the aquarium and pond exhibits, the poster exhibits, and the competitions during Aquaculture Week.

FishWorld maintains 18 units of 170-liter glass aquaria with water and air piped in from the nearby hatchery. At present, we have red tilapia, common carp, pacu, oscar, and cichlasomas in four freshwater aquaria, and a variety of species in 14 marine aquaria – milkfish, grouper, snapper, rabbitfish, sea bass, seahorse, stonefish, boxfish, pufferfish, tiger shrimp, mud crabs, lobsters, abalone, trochus, cleaner shrimp, sea star, and some others. The aquarium fixtures are now 4 years old and must be changed or improved for better animal presentation and better visitor appreciation. A canvass-lined freshwater pond was built in the indoor garden to hold ornamental carps, tilapias, and other freshwater fishes, plus 5 freshwater turtles. Despite the basic condition of the aquaria and the pond, children and other visitors enjoy the animals.

FishWorld houses the Museum of Aquatic Biodiversity, which includes three components. The Dry Collections consist of the dry skeletons of mollusks, echinoderms, corals, and crustaceans and the herbarium specimens of seaweeds. The Wet Collections include alcohol-preserved specimens of fishes, crustaceans, snakes, and other aquatic animals and plants. The Arts and Culture Gallery has fishing implements and fish-inspired or water-inspired artwork, ornaments, and household items.

Museum collections have increased markedly over the past four years. The biological collections now stand at about 3,000 different species of aquatic plants and animals. New collections in 2004 include shells from the Villa Arevalo beach, Igang Marine Station, mangrove areas in Bohol, and from Hua Hin beach in the Gulf of Thailand. Fish artifacts were also acquired during the same trips.

Training

A variety of training opportunities were made available by SEAFDEC/AQD to its many clients in 2004. Thirteen training courses were conducted by AQD at its Tigbauan, Dumangas, Igang, and Binangonan facilities for 109 participants from government, academe, and the private sector in the Philippines and other SEAFDEC-ASEAN Member Countries. Most of the lecturers and resource persons in these training courses were AQD's very own Scientists and Specialists, but some others were invited from the neighboring universities, or from the Member Countries.

Two faculty members of Cavite State University trained at AQD for five months on fish health management, freshwater fish hatchery and grow-out, and research methodologies. A special two-month training course in nutrition, feed development, and environment-friendly shrimp farming was also undertaken by two faculty members from the University of Mahajanga, Madagascar.

Prof. Weeny Tandang of Cavite State University at Naic

Prof. Hanitra Ratzimbazafy and Prof. Mamy Nirina Rajaonarivelo of the University of Mahajanga

Training courses	Duration	Trainees	Number, gender	Ages (yr)	Countries represented	Funding
Research Training for Faculty	2 Feb – 30 Jun	Teachers	21M + 1F	43-54	Philippines	Cavite State Univ, Naic
Detection of White Spot Syndrome Virus by PCR	15 – 18 Mar; 26 – 29 Apr; 18 – 22 Oct	Private sector, govt officers	135M + 8F	21-60	Philippines	NPPMPC 1; Marcella Farms 2; BFAR 10
Freshwater Aquaculture Operations and Management	15 Apr – 21 May; 21 Apr – 26 May	Teachers	117M + 4F	46-58	Philippines	Technical Education & Skills Dev Authority
Environment-Friendly Shrimp Farming and Aquaculture Nutrition	22 Apr – 28 May	Teachers	21M + 1F	33-48	Madagascar	World Bank
Marine Fish Hatchery	2 Jun – 16 Jul	Private farmers; govt officer	75M + 2F	23-54	Philippines, Vietnam,	ASEAN-SEAFDEC 1, Personal 4
AquaHealth Online	2 Aug – 17 Dec	Govt officers, private sector	2510M+15F	26-43	Philippines, Cambodia, India, Indonesia, Lao PDR, Thailand, Malaysia, Hong Kong, Myanmar, Vietnam, Singapore	GOJ-Trust Fund 19, NACA 1, personal 4, BFAR 1
Crab Seed Production	7 Sep – 6 Oct	Govt officers, teacher,private sector technicians	1512M + 3F	21-54	Philippines, Myanmar, Cambodia, Vietnam, India	ASEAN-SEAFDEC 3, LGUs 2, Pangasinan State U 1, personal 9
Mangrove-Friendly Shrimp Aquaculture	21 Oct – 9 Nov	Govt officers, private farmer	87M + 1F	25-45	Philippines, Cambodia, Indonesia, Malaysia, Vietnam, Myanmar, Thailand	ASEAN-SEAFDEC 7, personal 1
Abalone Hatchery and Grow-out	24-29 Oct; 17-26 Nov	Govt officers, LGUs, private sector farmers, technicians	2616M+10F	21-53	Philippines, Indonesia	ASEAN-SEAFDEC 1, BFAR-FRMP 10, personal 15
Total	13 sessions		109			

ASEAN Association of Southeast Asian Nations; GOJ Government of Japan; NACA Network of Aquaculture Centers in Asia, BFAR Bureau of Fisheries and Aquatic Resources; FRMP Fisheries Resources Management Project; NPPMPC Negros Prawn Producers Multi-Purpose Cooperative; LGU local government units

A hundred college students from 18 schools around the Philippines were accepted for practicum or on-the-job training (OJT) in the different laboratories at AQD Tigbauan and also in actual production work in the Dumangas ponds, Igang cages, Jalajala hatchery, and Binangonan ponds and cages. A student from the University of Reading undertook internship on mangroves, and two students from the University of Wales worked at the mudcrab hatchery for their theses under the European Commission project.

Internships (for a fee) and on-the-job training for students in 2004

Interns' Institution	Academic course	Assignment at AQD	Sessions	# by gender
Iloilo and Panay				
Phil Science High School - WV	Year 2	FishWorld	26 Apr - 21 May	3M + 12F
Univ Phil High School, Iloilo	Year 3	FishWorld	26 Apr - 21 May	1M + 5F
Univ San Agustin, Iloilo City	Year 4	FishWorld	26 Apr - 21 May	1M
AMA Computer Learning Center	Computer Science	Library	20 Jan - 20 May	2M
AMA Computer Learning Center	Computer Science	Library	6 Feb - 28 May	1M
West Visayas College of Sci. & Technology	BS Electrical Eng.	Engineering	29 Apr - 5 Jun	2M
Southern Iloilo Polytechnic College-WVCST	BS IT/Electrical Tech	Engineering	14 Jun –31 Oct	1M
Akalan State Univ	BS Veterinary Med	Fish health	8 - 19 Nov	3M + 6F
Iloilo State College of Fisheries	BS Fisheries	Abalone hatchery	18 Oct - 20 Nov	1M
Univ of the Philippines in the Visayas	BS Fisheries	Abalone hatchery	5 Nov - 5 Dec	2F
Individual, UP High School, Iloilo	Year 3	Fish health	31 May – 31 Jul	1M + 2F
Individual, Iloilo City	BS Commerce	Crab hatchery	26 Feb - 26 Mar	1M
Individual, Barotac Nuevo, Iloilo	BS Marine Biology	Abalone hatchery	04 Mar - 04 Apr	1M
Individual, Barotac Nuevo, Iloilo	BS Fisheries	Crab hatchery	11 Feb - 11 Mar	3M
Individual, Iloilo City	BS Fisheries	Fish hatchery	8 Nov - 7 Jan	2F
Outside Panay				
Sultan Kudarat Polytechnic State College	BS Fisheries & Tech	Shrimp & fish grow-out	4 Feb - 4 Mar	4M + 5F
Davao del Norte State College	BS Aqua Resource Eng'g	Shrimp grow-out	12 Apr - 21 May	2M + 6F
Davao del Norte State College	BS Fisheries	Tigbauan diff labs	25 Mar - 25 Apr	6M + 5F
Mindanao Polytech State College, Panaon	BS Aqua Res Tech Mngt	Tigbauan diff labs	16 Mar - 25 Apr	2M + 4F
Don M Marcos Mem State U, Ilocos Norte	BS Fisheries	Freshwater aquaculture	14 Apr - 28 May	3M + 6F
Central Luzon State Univ, Nueva Ecija	BS Fisheries	Freshwater aquaculture	15 Apr - 28 May	1F
Leyte State Univ, Tolosa	BS Fisheries	Freshwater aquaculture	17 May - 1 Jun	1M + 1F
Cavite State Univ, Naic	BS Fisheries	Tilapia hatchery	12 Apr - 8 Jun	9F
Central Luzon State Univ, Nueva Ecija	BS Fisheries	Tilapia hatchery	15 Apr - 14 Jun	2M
Mindanao State Univ, Naawan	BS Fisheries	Fish farming in cages	15 Apr - 24 May	4M + 3F
Mindanao State Univ, Marawi	BS Fisheries	Different laboratories	12 Apr - 21 May	2F
Southern Leyte State Univ - Bontoc	BS Fisheries	Crab hatchery, plankton	3 Nov - 26 Jan 05	1M + 2F
Individual, La Trinidad, Benguet	BS Educ	Shrimp hatchery	11 - 23 Mar	1M
Individual, Valencia, Ormoc City	BS Computer Science	Shrimp grow-out	13 Mar - 13 Apr	1M
Individual, Basak, Cebu City	BS Marine Biology	Algal isolation	05 - 10 Jul	1F
Individual, San Jose, Oriental Mindoro	BS Fisheries	Fish health	04 - 14 Oct	1M
Individual, Mandaue, Cebu City	BS Biology	Abalone hatchery	24 - 29 Oct	1M + 1F
Individual, Surigao	HS Graduate	Fish hatchery	3 Nov - 3 Dec	1M
Outside Philippines				
Univ Reading, UK	MSc Ecol Econ (thesis)	Farming systems	2 - 29 Feb	1M
Univ Wales, Bangor, UK	MSc (thesis)	Mudcrab hatchery	12 Jun - 9 Sep	1M + 1F
Total 20 institutions			**33 sessions**	**53M + 76F**

Finances

The Host Government of the Philippines (GOP) approved for 2004 a contribution of PhP 100 Million to the SEAFDEC Aquaculture Department through the Department of Foreign Affairs' International Commitment Fund. Fortunately for AQD, non-GOP external sources of funds were also available for various Departmental programs and projects in research, training and information, and technology verification and commercialization. There has also been a shift in the funding mechanism of the Government of Japan (GOJ) for SEAFDEC – from core type to the project type funding. Now, GOJ contributes to SEAFDEC through a Trust Fund, which is administered by the Secretariat in Bangkok. This GOJ Trust Fund provides the budget for the programs undertaken by the Secretariat and the four Departments under the ASEAN-SEAFDEC Fisheries Consultative Group mechanism.

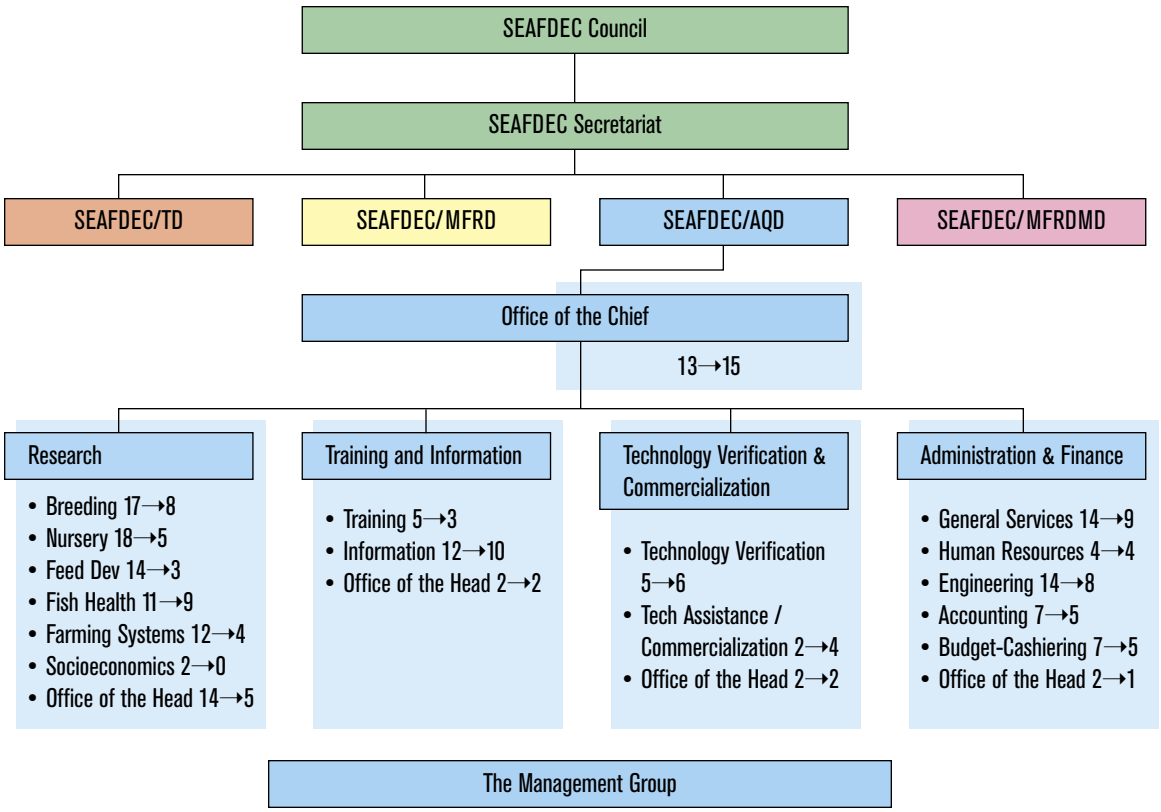
SOURCES OF FUNDS

Contributions	
Government of the Philippines	100,000,000
Government of Japan for	
ASEAN-SEAFDEC Sp 5-Yr Program	8,569,192
	108,569,192
External Grants	
European Commission Mudcrab Proj	1,602,178
Euriopean Commission ASEM Workshop	214,750
JIRCAS	1,291,664
Fisheries Research Agency Japan	701,661
AusAID-Pacap	975,000
USAID-Paris	405,140
Republic of Palau	907,231
JICA Third Country Training Program	106,281
University of Mahajanga, Madagascar	383,301
Cavite State University	500,000
TESDA-TVET Training Course	330,576
UNESCO-MAB-ASPACO	54,122
Private Sector collaborative grants	100,000
	7,571,904
Auxiliary Income	
Income of Research Division	
Service Laboratories	803,442
Collaborative Research Admin Cost Income	923,277
Integrated Milkfish Broodstock & Hatchery	209,860
Fish Hatchery	196,150
Abalone Hatchery	60,350
Mudcrab Hatchery	3,433
Catfish Hatchery	1,375
Sale of Books -EU-CMMS	138,316
Miscellaneous Income	191
	2,336,394
Income of Training & Information Division	
Training & internships	1,144,641
Sale of publications and videos	404,061
FishWorld income	156,369
Miscellaneous Income	207,290
	1,912,361
Income of Administration & Finance Division	
Housing rentals, TMS & BFS	1,793,672
Vehicle use	918,580
Interest/dividend income	50,221
Income from bidding of non-serviceable assets	347,911
Miscellaneous income	173,141
	3,283,525
Government of Japan Trust Fund	
Fish Diseases Project	
Fish Diseases Diagnostic Methodologies	6,253,859
Disease Surveillance System	5,011,512
Mangrove-Friendly Shrimp Culture	-
	11,265,371
DA-BFAR - JMANTTP	
Production income from JMANTTP projects	1,023,695
Private sector collaborative projects	678,522
	1,702,217
DA-BFAR Lab Adv Aqua Technologies	**4,000,000**
Total sources of funds for 2004	**140,640,964**

APPLICATION OF FUNDS

General Operating Expenses	
Personnel Services	62,714,474
Maintenance and other Operations	25,323,147
Capital outlay	814,107
Program Expenses	
Research Division	1,147,901
Training & Information Division	757,836
Technology Verification & Commercialization	413,290
	91,170,755
ASEAN-SEAFDEC Sp 5-Year Program	
Aquaculture for Rural Development	2,465,119
Supply of Good Quality Seeds	1,962,206
	4,427,325
Externally funded Projects	
European Commission Mudcrab Proj	2,081,927
European Commission ASEM Workshop	-
JIRCAS	1,420,669
Fishery Research Agency, Japan	278,681
AusAID-Pacap	758,497
USAID-Paris	1,791,143
Republic of Palau	942,773
UNESCO-Mangrove Handbook	653,657
Internat Foundation for Science Abalone Proj	185,564
JICA Third Country Training Program	106,281
ACIAR - Grouper Project	88,573
Degussa Texturant	212,004
Rovithai	72,056
University of Mahajanga Special Training Course	383,453
Cavite State University Faculty Training	216,942
TESDA-TVET Training Course	279,011
UNESCO-MAB-ASPACO Project	48,164
Private Sector-Collaborative Project	23,556
	9,542,950
GOJ-TF Projects	
Fish Diseases Project	
Fish Diseases Diagnostic Methodologies	5,300,327
Disease Surveillance System	1,078,716
Mangrove-Friendly Shrimp Culture	5,201,229
	11,580,272
DA-BFAR - JMANTTP Projects	
JMANTTP projects	2,399,319
Private sector collaborative projects	1,100,523
	3,499,842
DA-BFAR Lab Adv Aqua Technologies	**3,695,850**
Committed Funds	
Capital expenditures, research equipment	11,006,700
Ongoing programs and projects	5,717,270
	16,723,970
Total application of funds for 2004	**140,640,964**

Personnel and management



Rolando R. Platon	AQD Chief
Jurgenne H. Primavera / Rolando R. Platon	Head, Research
Teodora U. Bagarinao	Head, Training and Information
Wilfredo G. Yap / Dan B. Baliao	Head, Technology Verification and Commercialization
Dan B. Baliao / Tomas A. Sajo	Head, Administration and Finance

At the 36th SEAFDEC Council Meeting in Bangkok, the Council of Directors reappointed AQD Chief Dr. Rolando Platon for another two years effective 8 April 2004. The reappointment of Dr. Platon gives him fresh mandate to continue his programs at AQD according to his vision of AQD as a leader in the aquaculture sector and responsive to the aquaculture industry in Southeast Asia and the rest of Asia. The SEAFDEC Council sees Dr. Platon's programs and vision as conforming to, and fulfilling, the wider SEAFDEC mandate. Dr. Platon has already served eight years as AQD Chief.

SEAFDEC/AQD had a major retrenchment in 2003–2004 due to a reduction in the funds from the Government of the Philippines. Of 182 regular employees in January 2004, 24 availed of early retirement, some were not rehired on 15 July after the abolition of positions, others were rehired on fixed terms, and only 103 remained by 31 December.

AQD Scientist Ma. Rowena Romana-Eguia earned her PhD from Tohoku University, Japan. AQD Scientist Wenresti G. Gallardo was chosen the 2004 Outstanding Young Scientist (Marine Science) by the National Academy of Science and Technology. AQD Senior Scientist JH Primavera was awarded a PhD *honoris causa* by Stockholm University.

The streamlining of AQD

What happened

2003
GOP contribution of PhP150 Million was slashed by 25%. AQD was informed that GOP contribution for 2004 will only be PhP100 Million. A generous separation package was offered and 82 regular employees retired. For the remaining employees, the AQD-granted benefits were withheld. Many research studies could not be funded.

Anti-management street protests started in November and intensified towards April 2004. The media got involved and so did the Buyuan community.

9 January 2004
The Philippine Technical and Administrative Committee for SEAFDEC/AQD discussed the AQD situation brought about by severe budget reduction. Resolved the creation of the Research and Development Advisory Committee (RDAC).

20 January
RDAC was created by DA Secretary Luis Lorenzo.

4 February - 12 April
Series of RDAC meetings; recommended engagement of the Development Academy of the Philippines (DAP) on 17 March to conduct the organizational study.

8 April
AQD Chief RR Platon was reappointed by the SEAFDEC Council of Directors in Bangkok.

17 May
DAP submitted Rationalization Program for SEAFDEC/AQD. DAP study recommended core staff of 135, down from 180.

31 May
PTAC accepted DAP report and made recommendations.

10 June
PTAC Chair accepted the recommendations and directed DA Legal Counsel to assist AQD in implementing the streamlining.

16 June
Executive Order No. 1 on the Streamlining of AQD was issued. All positions were declared abolished effective 16 July 2004. All separation benefits were released pursuant to Department policies and the provisions of the Collective Bargaining Agreement. (Already 24 AQD employees availed of early retirement before the abolition of positions).

15 July
New positions were filled up, giving priority to employees qualified in light of new functions. The appointments were probationary or fixed-term, subject to review after 6 months.

16 January 2005
83 employees were retained as regular personnel, 13 got fixedterm project-based appointments, and 15 fixed-term employees got one-year extensions of contracts.

Pursuant to the recommendation of the Research and Development Advisory Committee, SEAFDEC/AQD entered into a Memorandum of Understanding with the Development Academy of the Philippines (DAP) for DAP to conduct a Rationalization Program for AQD. The task was assigned to DAP's Center for Governance, to the team of Ophelia Tongco (Head), Blanca Pasaporte, and Grace Gatarin. The team studied the issues and the facts, resources, circumstances, and other relevant data they obtained from AQD.

DAP then held a series of meetings and workshops with AQD's stakeholders in the Philippines. On 23 April, DAP conducted a one-day workshop at their office in Pasig on Strategic Direction Setting for AQD. In attendance were representatives of the Bureau of Fisheries and Aquatic Resources (BFAR), National Fisheries Research and Development Institute (NFRDI), Philippine Council for Aquatic and Marine Resources Research and Development (PCAMRRD), National Chamber of Fisheries and Aquatic Resources, University of the Philippines Visayas (UPV), Central Luzon State University, Philippine Aquaculture Society, Philippine Tilapia Association, Philippine Feed Millers Association, some fish farmers, and businessmen. From AQD, the Chief was there with the four Division Heads and two scientists.

The April workshop identified the strategic directions for AQD as follows:

- Domestication of economically important aquatic species
- Commercialization of responsible farming technologies to ensure food security, livelihood and export earnings
- Enhancing technology transfer
- Contributing to aquaculture production by providing solutions to problems confronting the industry
- Strengthening scientific expertise for aquaculture R&D and extension

The DAP team came to AQD Tigbauan on 6-7 May to see for themselves the research and training facilities of AQD and to meet the staff. At the General Assembly, Ms Tongco told the staff that they plan to give AQD four options–each option with assumptions and with consequences in the long term. DAP submitted their Rationalization Program for SEAFDEC/AQD in May.

DAP then conducted a Strategic Planning Workshop at AQD Tigbauan on 18-20 August with representatives from AQD, University of the Philippines Visayas, Mindanao State University in Naawan, MSU Iligan Institute of Technology, BFAR, NFRDI, PCAMRRD, and the Research and Development Advisory Committee. The participants analyzed the AQD environment to identify and focus on critical issues.

The August workshop defined the new AQD vision. The participants also conducted a SWOT analysis and listed AQD's strengths, weaknesses, opportunities, and threats. A goal-setting session identified ways and targets for improved customer service, financial status, internal processes, and innovation and learning. The roles of the cooperating national institutions and agencies for the development of sustainable aquaculture in the country were also discussed.

AQD staff learn to apply the logical framework for AQD programs

It was also decided that AQD should adopt the program approach, rather than the discipline-based approach, in carrying out its mandated work. At present, AQD implements seven programs, but these that are not yet fully integrated because the implementors have not been similarly grounded at the beginning. DAP recommended that AQD should use the logical framework for program planning and implementation.

Thus, on 21-22 October, AQD researchers and staff had a workshop on the logical framework for program planning and implementation, facilitated by staff of the University of the Philippines Visayas. The 'log frame' was a good lesson for everybody at the workshop, and promises to be a good method for accomplishing the objectives of AQD.

Even as AQD endeavors to define its responsibilities relative to other Philippine R&D institutions funded by the Government of the Philippines, it also has to live by the SEAFDEC Strategic Plan:

- Emphasize regional issues and anticipated threats
- Promote efficient and sustainable fisheries
- Exchange intra-regional expertise and information
- Create mechanisms for regional collaboration
- Avoid duplication of efforts
- Increase the visibility of SEAFDEC activities

AQD's Pasko sa Dagat was gift-giving time (300 gifts for 300 kids)

AQD's vision:
AQD is an Agent for Quality Development in aquaculture

Strategies and plans

- Reengineer the AQD organization from a bureaucratic system to a program matrix in which divisions work together
- Expand and strengthen collaboration with SEAFDEC Member-Countries, academic and research institutions, and government agencies
  - Mobilize experts from SEAFDEC Member Countries
  - BFAR/NFRDI staff detailed at Biotech Lab
  - University faculty as affiliate researchers at AQD
  - Graduate students to work on aquaculture theses
- Assess the socioeconomic impact of AQD's R&D programs
  - Measure level of success in use of aquaculture technologies for sustainable production and increased family income
  - Measure AQD contribution towards improvement of quality of life of the fisherfolks in the coastal areas
- Build an innovative and enterprising institution that can generate revenues

  Research: hatchery production, natural food, laboratory and diagnostic services

  Training and Information: training courses, books, manuals

  Technology Verification: consultancies

  Administration and Finance: housing, vehicle use, income from unused resources
- Install revenue-oriented comprehensive asset management program
- Fully computerize Budget, Cashiering, Accounting, and Internal Audit
- Improve internal and external communication systems
- Strengthen community relations to ensure security in the neighborhood

AQD at 31: New beginnings, new challenges

We celebrate the 31st anniversary with mixed feelings. We are glad that SEAFDEC/AQD has reached 31 years of productive existence, but sad that AQD has to resort to staff reduction for continued existence.

It is important for all stakeholders to understand the circumstances that influenced the present state of AQD. The severe reduction of the AQD budget from the Host government of the Philippines calls for reduction of staff and reduction in compensation package. The study conducted by Development Academy of the Philippines indicates the need to streamline AQD's personnel and programs consonant with its mandate but within the budget constraints.

One major strategy for this change is to focus resources on programs that have maximum impact on the clientele. AQD should be involved not only in mainly technical activities but also in policy-oriented ones. AQD should intensify its efforts toward integrating responsible aquaculture technologies into the national developments plans of Member Countries. AQD should also intensify technology demonstration and generate income to augment funds for operations.

AQD is not unique. Like other organizations, SEAFDEC had to undergo reorganization after 30 years. Change is necessary to move forward. In fact, AQD had already made adjustments when the larger SEAFDEC organization went though a major change after it turned 30 in 1997. In 1998, the SEAFDEC Council adopted the new SEAFDEC Strategic Plan to be used to realize its mandate and goals.

The SEAFDEC Strategic Plan says that SEAFDEC must:

- *Emphasize regional issues and anticipated threats*
- *Promote efficient and sustainable fisheries*
- *Exchange intra-regional expertise and information*
- *Create mechanisms for regional collaboration*
- *Avoid duplication of efforts*
- *Increase the visibility of SEAFDEC activities*

Toward this end, regional programs have been carried out by SEAFDEC starting in 2000 in collaboration with the ASEAN through the Fisheries Consultative Group mechanism. AQD is now implementing three regional programs under this ASEANSEAFDEC collaborative mechanism:

- *Mangrove-Friendly Shrimp Aquaculture with Thailand as the Lead Country for the ASEAN*
- *Regional Fish Diseases Program with Thailand as the Lead Country for the ASEAN*
- *Integrated Regional Aquaculture Program (Aquaculture Component of the ASEAN-SEAFDEC Special Five-Year Program) comprising two projects:*
  - *Aquaculture for Rural Development with Vietnam as the Lead Country for ASEAN*
  - *Supply of Good Quality Seeds with Indonesia as the Lead Country for ASEAN*

Arguments have been made regarding the core competence of AQD, and how it should be maintained. AQD did have the competence, but much still had to be done in delivering the end results. There should be a paradigm shift from core competence to cost efficiency. The bottom line should be how efficiently AQD could deliver results or the output of its programs. AQD would be more efficient if it outsourced some of the experts for its programs, since it need not maintain these experts through the years. AQD's recent experience with drastic budget cuts showed that many of its in-house experts were not fully occupied due to lack of operating funds, but were paid full-time salaries. Like other international R&D institutions (WorldFish Center, SEARCA, and others), AQD must now have a minimum number of core staff and the required number of project staff. Recruitment of most of the personnel would be by project, and employment ends with the project.

What is in store for AQD? Today, AQD's 31st anniversary is a new beginning. We expect new challenges, not only in terms of new employment status and more responsibilities for our staff, but also in terms of new mindsets and perspectives. It will not be 'business as usual' at AQD because the new directions and programs will be a different ball game. New perspectives mean new approaches. AQD will strengthen the program approach in planning and implementing Department activities. AQD requires a strong sense of commitment from its employees. With this commitment, we hope to overcome the obstacles and live up to the expectations of our Member Countries.

Happy 31st Anniversary!

Message of AQD Chief RR Platon during the AQD Anniversary Program on 9 July 2004

9 July 2004 was SEAFDEC/AQD's 31st anniversary, and it was celebrated simply and somberly amidst an ongoing streamlining due to a drastic reduction in the funds from the Host Government of the Philippines. In the morning, there was a thanksgiving mass, followed by awarding ceremonies, the Chief's message, then potluck lunch and raffle. AQD awarded Certificates of Distinguished Service to its employees (as of 16 July 2004) for having helped AQD through its many responsibilities, achievements, and challenges, and for having stayed until the 31st anniversary.

The afternoon was for service to clients. AQD launched several new books and gave away more than 150 free copies of AQD publications (page 31).

FishWorld matters

SEAFDEC FishWorld continues to serve the general public as AQD's visitor center, museum of aquatic biodiversity, and science and environment education center. In 2004, FishWorld received 16,620 visitors in 170 groups (129 schools) and earned P173,865 in entrance fees. The much-appreciated museum collection now has about 2,500 species of fishes, gastropods, bivalves, crustaceans, corals, echinoderms, and other aquatic animals and plants. FishWorld documented in 2004 the stranding or capture of five green turtles *Chelonia mydas*, an olive ridley *Lepidochelys olivacea*, a dugong *Dugong dugon*, and a megamouth shark *Megachasma pelagios*. SEAFDEC/AQD and DENR Region 6 inked a Memorandum of Agreement on 25 August 2004 for the former to provide tank facilities for the rehabilitation of stranded or sick endangered marine animals.

The 5-meter long megamouth shark, stranded at the beach of Namocon, Tigbauan on 4 November 2004 and transported to SEAFDEC FishWorld the next morning, was only the 26th specimen ever recorded around the world.

The FishWorld staff documented, tagged, and released four turtles that got caught in fish traps in Tigbauan. Two of these were kept at the AQD concrete tanks 1-2.5 months until they were taken by pump boat and released off Igang, Guimaras. Two other very sick turtles were rescued in September by personnel of the Protected Areas and Wildlife Bureau of DENR Region 6, and turned over to FishWorld for rehabilitation–one green turtle with a fractured skull died after 18 days in the AQD tanks, and an olive ridley that was blind and emaciated died after four days.

A baby dugong was caught near shore at Morobuan, Jordan, Guimaras on 25 April and brought by the locals to AQD's Mariculture Park in Igang. Personnel of DENR's Pawikan Conservation Project decided to transfer the dugong to Tigbauan Main Station on 29 April. It was cared for by EF Doyola and the DENR veterinarian, but died after 10 days. The problem was still the lack of proper food (in place of mother's milk). Last year's other dugong also died of diarrhea (from taking human infant formula) and a wound from a cookie-cutter shark.

Tagging a green turtle before release

FishWorld conducted the R&D Internships for 21 students from the Philippine Science High School Western Visayas and the University of the Philippines High School in Iloilo, from 26 April to 21 May. FishWorld also held Aquaculture Week on 26-30 July. Fifteen elementary schools (78 contestants, 52 coaches) participated in eight contests and 15 high schools (72 contestants, 43 coaches) in nine contests (photos on next page).

Aquaculture Week 2004

SEAFDEC/AQD responds to the Philippines

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 to promote fisheries development in the region. The Member Countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The policy-making body of SEAFDEC is the Council of Directors, made up of representatives of the Member Countries.

SEAFDEC conducts research on fisheries problems; generates appropriate fisheries technologies; trains researchers, technicians, fishers and aquafarmers, and managers; disseminates information on fisheries science and technologies; and recommends policies pertaining to the fisheries sector.

SEAFDEC has four Departments that focus on different aspects of fisheries development:

- The Training Department (TD) in Samut Prakan, Thailand (1967) for training in marine capture fisheries
- The Marine Fisheries Research Department (MFRD) in Singapore (1967) for post-harvest technologies
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines (1973) for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia (1992) for the development and management of fishery resources in the exclusive economic zones of SEAFDEC Member Countries

SEAFDEC/AQD is mandated to:

- Conduct scientific research to generate aquaculture technologies appropriate for Southeast Asia
- Develop managerial, technical, and skilled manpower for the aquaculture sector
- Disseminate and exchange aquaculture information

The Aquaculture Department in the Philippines maintains four stations: the Tigbauan Main Station and Dumangas Brackishwater Station in Iloilo; the Igang Marine Station in Guimaras; and the Binangonan Freshwater Station in Rizal.

Tigbauan Main Station

Dumangas Brackishwater Station

Igang marine Station

Binangonan Freshwater Station

Aquaculture Department (AQD)
5021 Tigbauan, Iloilo
Philippines
PO Box 256, 5000 Iloilo City
Philippines
Tel: (63 33) 511 9171; 336 2891;
336 2965
Cable: seafdec iloilo
Fax: (63 33) 335 1008; 511 8709
E-mail: aqdchief@aqd.seafdec.org.ph
http://www.seafdec.org.ph

Training Department (TD)
PO Box 97
Phrasamutchedi
Samut Prakan 10290
Thailand
Tel: (66 2) 425 6100
Fax: (66 2) 425 6110, 425 6111
E-mail: td@seafdec.org
http://www.seafdec.org/td/

Marine Fisheries Research Department (MFRD)
2 Perahu Road off Limchukang Road
Singapore 718915
Tel: (65) 790 7973
Fax: (65) 861 3196
E-mail: mfrdlibr@pacific.net.sg
http://www.seafdec.org/mfrd/

Marine Fishery Resources Development and Management Department (MFRDMD)
Fisheries Garden, Chendering
21080 Kuala Terengganu
Malaysia
Tel: (60 9) 616 3150 to 52
Fax: (60 9) 617 5136
E-mail: seafdec@po.jaring.my
http://www.seafdec.org/mfrdmd/

SEAFDEC Secretariat
Suraswadi Building
Department of Fisheries Compound
Kasetsart University Campus
Chatukchak, Bangkok 10900
Thailand
Tel: (66 2) 940 6326 to 940 6329
Fax: (66 2) 940 6336
E-mail: secretariat@seafdec.org
http://www.seafdec.org

SEAFDEC Secretariat
P.O. Box 1046
Kasetsart Post Office, Bangkok 10903
Thailand